Stock Message Board Recommendations and Share Trading Activity

by

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Certificate

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Abstract

The efficiency of capital markets is largely attributable to an effective information network that exists among market participants that include fund managers, analysts, and investors. The role of many market participants is to improve the flow of information to assist the market in becoming aware of, and understanding, information. In this work, we look at the role of message boards in improving market efficiency. We examine the impact of message boards on stock returns, volatility, trading volume and liquidity. The overall findings of our study are that message boards serve no useful purpose for stock returns and liquidity. However, message boards do seem to add risk to share trading by increasing the turnover and share price volatility. We also observe that message board participants are likely to follow the stock market activity. Our results make one think that participation in message boards serves more for social purposes such as interaction with like-minded investors, general amusement etc than anything else.

Chapter I: Introduction

This chapter gives a brief introduction to the research topic. The chapter begins with a background discussion of the research to highlight the importance of studies on stock message boards in academic contexts. The chapter provides a brief explanation of the research problems and the methods used in our work to address these issues. It then discusses the contribution of our work to the current body of finance literature that examines message boards. The chapter concludes with an outline of the whole thesis.

1.1 Background to the Research

The information networks of market participants are a key to capital market efficiency. With the emergence of the internet in the 1990s as a means of communication and of information gathering, the flow of information changed forever. The internet is continuously evolving as a mainstream form of communication. In addition to websites, there are different applications on the internet such as chat sites, email and message boards that are heavily used. Such advances in internet technology, along with increased access to the internet, have changed social interactions. In recent times, people have gained the privilege of learning from others through the use of internet-based discussions. Online discussion forums are an organised form of virtual community where members can interact, debate and exchange information. The interest of financial market participants (investors, fund managers, analysts etc.) in this type of discussion has been growing and as a result, as in many other industries, there has been an explosion of virtual communities for financial market participants. Stock message boards are one such type of online discussion forum for financial market participants

where investors (or potential investors) can interact with other investors (or potential investors). An example of a typical post on a message board reads as follows:

"muzz,

I don't think many of us thought OPR was worth much to MMX, it's clearly been the concrete shoes on MMX's feet as it struggles to stay afloat.

Getting rid of OPR, or at least its direct stake in it, has been both desireable and pretty much inevitable for a while now.

The big worry is what MMX will have left afterwards. I for one would like to see the situation reversed, with Sinosteel taking over OPR and MMX being the ones whinging about tariffs.

Sounds like we will shortly find out anyway."

Source: HotCopper (2011)

In this message a poster, nicknamed *psi81,* expresses his views about Murchison Metals Ltd on *HotCopper* on 11 September 2011. This is one example of the many investor interactions taking place on internet discussion sites every day.

Stock message boards allow members to swap investment tips and strategies, and participants on stock message boards can access messages posted by fellow members instantly, easily and in most cases for free. Participants can usually remain anonymous on stock message boards and a typical board offers access to a combination of forum topics, research, education and news. Unlike chat rooms, communication channels are not one-to-one and anyone can read and respond to messages. Users of these message boards have to register with the forum to post messages and they must comply with forum terms and conditions. Moderators continually monitor message board activity and can remove messages, and can even suspend users, if they contravene

the posting guidelines. There are several paid and free message boards available to investors. Some of the popular finance message boards that have been examined in previous studies are *Yahoo! Finance, The Motley Fool,* and *Raging Bull.* In Australia, popular message boards include *HotCopper*, *Aussie Stock Forums* and *TopStock.*

There has been a huge growth in message-posting activity since stock message boards first started on *Yahoo! Finance* in 1997. Stock message boards have become very active in recent times and the number of participants appears to grow continually. There is no formal chronological record of how message board activity is growing over time. However, by comparing studies conducted at different times on *Yahoo! Finance*, we can observe a significant growth in the number of participants who follow the message boards. As reported in Pleis (2007), there were about 12 million registered users on *Yahoo! Finance* in February 2006. Another recent study by (Park et al. 2010), citing comScore Media Matrix (2010), reports a significant growth in the number of message board users to 41.4 million unique visitors by May 2010. In the Australian context, *HotCopper*, which claims to be Australia's largest independent stock market discussion forum, reports about 150,000 active members and more than 5,000 posts every day on its internet discussion site (HotCopper 2011).

With the increasing popularity of message boards, service providers are continuously improving discussion sites to offer more user-friendly features to their users. Some improvements include the ability of users to rate posts and their posters, stock tipping competitions, and even provisions for company representatives to officially join the forum. The continuous innovations and ever-improving features being offered by these discussion sites suggest that message boards have the potential to become more interactive and to reach wider cross-sections of the investor community.

1.2 Research Problem

The massive number of users and the considerable amount of time spent by these investors on message boards in reading, posting and commenting on the messages raises the question of whether message boards can influence investors' decision making processes. Investors may be using message boards as another way of gathering company information and investors' participation may primarily be driven by the expectation of potential economic benefits. In addition to this, message boards offer some social benefits to their members as they enable interaction among like-minded investors. It is interesting to see whether these interactions translate into economic benefits and whether or not message boards contribute to the efficiency of stock markets. The contribution of message boards to stock market efficiency is examined by observing trading variables such as stock returns, trading volumes, liquidity and volatility. If the message boards do have an impact on these trading variables, it will also be interesting to see the nature of that impact (i.e. positive or negative impacts). If message board participation has no economic significance, then it may just be serving a social purpose by providing a forum for like-minded people where participants share their opinions with each other.

There is growing evidence in the finance literature that stock message boards are associated with stock trading variables such as share price and trading volume (see for example Wysocki (1999)). Most prior studies on message boards look at their impact on stock price behaviour (see for example Tumarkin & Whitelaw (2001), and Sabherwal, Sarkar & Zhang (2008)) and results so far have been contradictory. In addition, it is still unclear whether or not message boards influence other trading variables such as trading volume, volatility and liquidity. The sample periods used in previous studies are short (generally a year) which raises the question of whether their findings are valid for

longer periods. A major contribution of our work is to provide empirical tests that evaluate a much longer data set. In addition to stock returns, our study investigates the impact of message boards on stock volatility, turnover and liquidity. We also study the biases in message board recommendations and how message board activity prior to the company news events influences investors' reactions to that news.

1.3 Research Method

To examine financial relevance of message board, we study over 1.5 million messages posted on the Australian internet discussion site, *HotCopper*, on the 764 of the 1000 largest firms (by market capitalisation as of 17 July 2009) listed on the Australian Stock Exchange. Our study period is the five years from January 2004 through to December 2008. We conducted five empirical studies to examine the role of message boards on market efficiency and to provide insights into the behaviour of message board participants. The first three studies are aimed at measuring the impact of normal and abnormal message board activity on stock returns, share price volatility, stock trading volume and liquidity. We use daily measures of message board variables and other variables that are considered to be important in describing trading activity in these studies. The fourth study uses monthly data to study the inherent biases in message board recommendations and to see if there are any economic benefits from message boards after controlling for these biases. Our final study is designed to look at message board behaviour around the days on which company news is presented. In this fifth empirical work, we also explore whether pre-event discussion on message board systematically influences the reaction of investors to news releases.

From our work, we find evidence to suggest that message boards do not serve as a source of information for investors and as a result, their contribution to market

efficiency is mixed. We do not find reliable evidence to relate message boards to future stock returns. If anything, message board recommendations are likely to lead to poor returns and those returns are only evident on the day following the recommendations. Volatility and trading volume are likely to increase after abnormally high levels of message board activity but the impact on liquidity is not significant. We note biases in message board recommendations towards growth firms, large firms and firms with share price momentum. After controlling for these biases, we find there is no contribution to future returns. An elevated level of message posting is recorded around the release of unscheduled news and the level of pre-event discussions can magnify positive (or negative) share price reaction to positive (or negative) news.

1.4 Contributions

Our findings contribute to the finance literature that investigates recommendations made in virtual communities such as stock message boards. We complement the current body of literature in three ways. First, our study is related to measuring the effect of message board recommendations on stock trading variables. In addition to stock returns, we present a detailed examination of trading volume, share price volatility and liquidity. Second, we investigate the economic usefulness of message board recommendations to their users, after controlling for inherent biases in recommendations. Finally, we contribute to the understanding of the role of message boards in investors' reactions to company news. Message boards may or may not directly affect trading, but speculation about the arrival of news and the subsequent digestion of news content can have some association with trading activity.

1.5 Outline of the Thesis

The rest of this thesis proceeds as follows. Chapter 2 provides a general review of the existing literature relating to stock message boards. We present a detailed chapter-specific literature review in each subsequent chapter. Chapter 3 describes the data and research methods employed in this study. Methods such as the computation of recommendation measures that are common to all studies are discussed in this chapter. We also present a detailed description of message board data and other financial data obtained from various sources in this chapter.

Chapter 4 reports the impact of message board recommendations on stock returns. The effects of both normal and abnormal levels of message board activity are presented in this chapter. Chapter 5 reports the study conducted to measure the impact of message boards on stock volatility. The results of simple empirical tests to compare volatility before and after abnormal message board events are discussed in this chapter. Chapter 6 reports on the trading volume and liquidity consequences of message board recommendations. The impact on these variables is measured by both normal and abnormal message board activity. We report the results of biases in message board recommendations in Chapter 7. The outputs of regression models used to measure economic usefulness, after controlling for these biases, are discussed in this chapter. Chapter 8 examines message board behaviour around days on which company news is released. Empirical tests to measure how message boards contribute to firms' informational environments are also discussed in this chapter. Finally, Chapter 9 offers conclusions drawn from our five different empirical studies. We conclude our final chapter by briefly describing the limitations of our study and suggesting directions for future research.

Chapter II: Literature Review

The previous chapter provided an introduction to the thesis by presenting a background discussion of the research. The chapter briefly defined the research problem and outlined the structure of the thesis. In order to establish the research problem and formulate the research hypothesis, this chapter reviews the literature relevant to stock message boards. The chapter begins with an examination of discussions on message boards and of why investors are likely to take part in such discussions. This chapter also includes a discussion on how such message board postings could contribute to market efficiency. The chapter closes by performing knowledge gap analysis and justifying the need to conduct further studies on message boards.

2.1 Stock Message Boards

As discussed earlier, stock message boards provide an online platform where market participants can interact with other investors, exchange information and debate issues. Stock message boards allow investors to swap investment tips and strategies. Investors can usually read and write messages for free but on some discussion sites, members are required to pay to access the website. Since the posters can use nick names, there are questions about the quality and reliability of information posted on the message boards. Each message board has its own posting guidelines and voluntary moderators are nominated to take action against breaches of these guidelines. Messages containing personal attacks and abusive language are considered to breach of posting guidelines, and this may result in moderation of posts and, depending on seriousness of the breach, members may even be suspended temporarily. With the increasing popularity of message boards, there has been a huge growth in the number of message

board providers. Some of the popular finance message boards that have been used in previous studies are *Yahoo!Finance, The Motley Fool,* and *Raging Bull.* In Australia, popular message boards include *HotCopper*, *Aussie Stock Forums* and *TopStocks*.

Through message board postings, information is expected to flow quickly to market participants. However, vast amounts of information readily available on the internet may make it hard for market participants to evaluate the quality of the information. Message boards may also encourage investors who would otherwise be on the sidelines due to limited resources, to trade stocks. Even active investors may be tempted to trade more often because of frequent communication with fellow investors. As such, message boards have the potential to influence trading activity and a discussion on the potential reasons why investors use message boards is presented in the next section.

2.2 Influence of Message Boards on Investment Decision Making Processes

Investment decisions are about predicting future events. Investors are always in search of new information which will enable them to feel confident about their investment decisions and as such, they are likely to use multiple sources to acquire information. Participation in social interactions could be an attempt by investors to increase their information base. While the question of how individual investors form their beliefs when making investment decisions is still being explored, it has been established that the decision making process is influenced by participation in social interactions (Pleis 2007). Social interactions help investors observe what fellow investors are doing, which may cause investors to ignore their own private information. For example, individuals may be more likely to purchase a house if their colleagues are buying similar houses. Alternatively, individuals may follow their colleagues in

accumulating savings for their retirement. Hong, Kubik and Stein (2004) using US health and retirement data, find that households who socialise more with their neighbours are more likely to invest in the stock market than those who do not. Their findings remained robust to factors such as wealth, race, education, and risk tolerance. Another study by DiFonzo and Bordia (1997) using two stock market simulations found that despite denials by investors, rumours influenced their trading decisions.

Participation in stock message boards could influence investor sentiment towards stocks. Several studies such as Tetlock (2007), Baker and Wurgler (2006) , Kaniel, Saar and Titman (2004), Kumar and Lee (2006), and Sankaraguruswamy and Mian (2008) show a significant relationship between investor sentiment and stock market activity. Hirschey, Richardson and Scholz (2000) examined the stock price effect of online stock recommendations obtained from *The Motley Fool* and conclude that the effects of recommendations made on internet sites are as effective as second-hand buy-sell recommendations published on the traditional print media. However, the quality of internet recommendations depends on the sophistication of investors. Similarly, Pleis (2007) found that non-professional investors' decision making is easily influenced by negative messages posted on the internet.

2.3 Motivation for Message Board Participation

As indicated in the previous chapter, the number of participants using message boards is on the rise. Studies have shown that a wide spectrum of investors participate in stock forums. For example, the users of message boards range from small investors (Das, Martínez Jerez & Tufano 2005) and day-traders (Wysocki, 1999; Koski, Rice & Tarhouni , 2004), to professionals/institutions (Bagnoli, Beneish & Watts, 1999) and corporate insiders (Carson and Felton, 2004). Investors may have different reasons for

visiting message boards, and these reasons may change from time to time. The significant number of participants and the considerable amount of time being spent by them on message boards raises the question of why investors are turning in such online discussions. We discuss two likely reasons: potential economic benefits and social benefits.

There is no doubt that making profits is the key motivation for any investment. Investors' flocking to message boards can be considered as an attempt to maximise profits from investments or potential investments. Lerman (2010) examine 1.94 million messages posted on *Yahoo! Finance* for 1858 firms between April 2007 and March 2008 and show that individual investors pay considerable attention to accounting information. However, the study does not find any evidence that the quality of the information base is improved by following message board postings. Consequently, there is no clear indication of better investment performance as a result of message board participation.

Irrespective of the possible economic benefits, participation in message board discussions may also serve social purposes. Message boards enable participants to associate with other like-minded investors. Such discussions on virtual communities can be on any issues related to their investments. Das, Martínez, Jerez and Tufano (2005) performed a clinical study of investor discussion and sentiment, and report four potential explanations for message board activity: (1) desire to learn; (2) complementing professional analysts; (3) interaction with colleagues; and (4) self-esteem. The study uses a subject, called Glen, and performs a clinical analysis of why he spent time on message boards. Glen lived in a small town of 15,000 people and message boards were the only way to learn as there were no investment clubs in his town. He also felt that while his online colleagues did not have any inside information, professional analysts

missed many details about the firms. He used discussion boards to test out his analysis. Message boards also provided Glen with an opportunity to interact with friends he enjoyed. Message boards allowed him to engage in enjoyable debates and to earn the respect of others.

Investors might be using message boards as a way of learning because participants exchange technical analyses, and they discuss their expectations about the firm. Individuals with limited investment knowledge may find these posts interesting and another source of learning. Messages are posted in informal and conversational language, which makes it easier for new investors to understand complex jargon. Interaction with colleagues may also help confirm an individual's prior beliefs or to evaluate their opinions relative to those of others. Gu, Konana and Chen (2008) study messages posted on *Yahoo! Finance* over 29 Dow Jones stocks between 1 January 2004 and 31 December 2006 and suggest that individual investors are motivated to interact on virtual communities to decrease dissonance between their own opinions and those of the investment community. Another recent study (Park et al. 2010) suggests that individuals' interactions with colleagues on virtual communities are likely to confirm their prior beliefs. Park et al. (2010) conducted a field experiment on a South Korean message board and find that investors are seeking information on online discussion sites to confirm their prior beliefs. Apart from confirmation of prior beliefs, message boards also offer investors an opportunity to assess their opinions relative to those of their fellow investors.

2.4 Extant Message Board Literature

The extant body of literature on message boards shows some association between message board activity and stock trading activity but opinion is still divided as

to whether message boards predict or just follow the stock market. We present the message board literature representing both sides of the argument as outlined below.

Message board predicts the market

One strand of research on message boards is on their predictive power over stock returns. Prior studies on this theme suggest that message board discussions tend to have an impact on trading over the short term. However, studies do not agree about the nature of the impact. For example, Wysocki (1999) studied messages posted on *Yahoo! Finance* for over 3,000 firms and document that messages contain some information and that the volumes of overnight message postings are indicative of trading volumes and stock returns on the next day. Sabherwal, Sarkar and Zhang (2008) provide further findings in support of predictive power of message boards. They analyse the ten most actively discussed stocks on *TheLion.com* and report that the numbers of messages posted are positively related to abnormal returns on the day of the postings and on the subsequent day. Message boards in both these studies appear to show a positive effect on stock returns and trading volume. On the other hand, Antweiler and Frank (2004) examined over 1.5 million messages posted on *Yahoo! Finance* and *Raging Bull* regarding 45 companies from the Dow Jones Industrial Average and the Dow Jones Internet Index and they report that volumes of message postings help predict market volatility. They also find that an increased number of postings is indicative of negative return on the next day, which suggests that message board postings have a negative impact on investment performance.

Message boards follow the market

Prior studies on this side of the argument support the efficiency of stock markets and suggest that message boards are just a reflection of the stock market. Tumarkin and

Whitelaw's (2001) study a total of 181,633 messages posted on the *RagingBull* discussion forum for internet service sector stocks between 17 April 1999 and 18 February 2000. They observe that on days with abnormally high message posting activity, changes in investor sentiment[1] are correlated with abnormal industry-adjusted returns. However, they do not find message posting to have predictive power over returns and trading volume. Das, Martínez Jerez and Tufano (2005) conducted a clinical study of investor behaviour using *The Motley Fool* message board. They studied four firms over a period of seven months and find that stock returns drive posters sentiment, not the other way around. More recently, Koski, Rice and Tarhouni (2007) studied the impact of noise trading on volatility by using posts on *Raging Bull* and *Yahoo! Finance* as a proxy for day trading. They find that the level of day trading activity is correlated with volatility, with the direction of causation being from volatility to day trading.

2.5 Message Board and Market Efficiency

In an efficient market environment, discussions held on stock message boards should have no effect in stock trading variables such as returns, trading volume, share price volatility and liquidity. As the quality and content of information available on message boards is always debated, investors can easily be misled by posts that have been made for vested interests. For the message boards to have an impact on stock returns, they should bring a new piece of information to the investors. Since message boards unregulated information environments, they can enable people to post rumours and manipulative posts.

A rumour is as an unconfirmed piece of information and rumours are a long-standing phenomenon in stock market investing. As stock message boards bring many

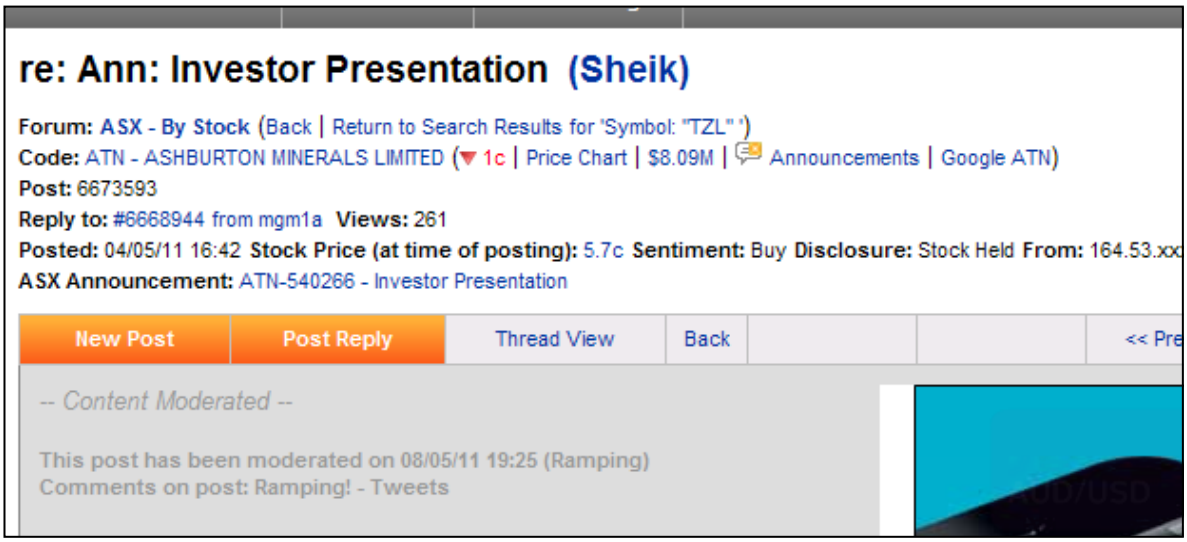
[1] Tumarkin & Whitelaw (2001) measure changes in investor sentiment as the difference between daily weighted opinion

investors together, and this makes these sites vulnerable to rumours. Rumours can originate from within the community of the message board or the message board can provide the medium for people to spread rumours. A recent media report (Roberts 2011), for example, shows how easily these rumours can influence trade in a stock. A user posted a fake drilling result on *HotCopper* for Voyager Resources Limited, which had a market value of $94 million. This post resulted in 58 million shares changing hands within an hour and the company was forced into a trading halt on the Australian Securities Exchange. Clarkson, Joyceb and Tutticci (2006) studied 189 takeover rumours posted on *Hotcopper* between 1 May 1999 and 31 March 2000 and find that there was a significant positive abnormal return on the day the post was made on internet discussion sites. Similarly, Bettman, Hallett and Sault (2007) studied 2,898 takeover rumours disseminated on *Yahoo! Finance* between January 2003 and December 2008 and show that message board rumours generated positive abnormal returns and trading volume in pre- and post-rumour dissemination periods.

In addition to rumours, stock message boards provide the opportunity for investors to 'pump-and-dump' stock prices. A typical pump-and-dump scheme involves a shareholder posting well-articulated and favourable information on a stock in an attempt to increase the share price. When the share price is pumped up, the poster then offloads his/her shareholding, leaving the new buyer with overpriced shares. Given that new investors may use message boards for investment tips and insights, this type of stock price manipulation can result in more share trading. Stock message boards usually have a few administrators to moderate the posts that do not conform to posting guidelines. Offending messages are deleted as soon as they come to the notice of moderators who label the post with the reason for the moderation such as ramping or

profanity. Figure 2.1 shows a snapshot of a moderated post on *Ashburton Minerals Limited* and the reasons for moderation is given as 'Ramping'.

Figure 2-1: Moderation example on HotCopper



This type of manipulation attempt can influence a firm's share price. Delort et al. (2009) study posts on *HotCopper* that were moderated due to ramping from January 2008 to December 2008 and show that ramping events are positively related to market returns, volatility and trading volume. They also report that firms with high trading volumes, low price levels, low market capitalisation and high volatility are likely to receive a higher proportion of ramping posts than others. While there are quite a few posts that are moderated, not all manipulative posts are likely to be moderated. There may be messages intended to pump up stock prices that are well-written and clever enough not to get caught by moderators.

Another consequence of message board activity is that it can increase the volume of information that is readily available. Message boards facilitate frequent communication between investors and this increases the likelihood that they will trade in concert. Brown (1999) suggests that when noise traders act in concert, they can

increase the volatility of the market. Voluminous postings on message boards offer investors easy access to information[2] but it is not clear whether there is any benefit in using this information. Despite some posting guidelines, message boards largely remain an unregulated information environment. For this reason, information of both good and questionable quality may originate and be disseminated via message boards. In fact, there have been several instances of misinformation being spread through the information network via stock forums (see Buckman (1999), Regnier (1999), Weiss (2000), Bischof (2001)). With the increase in the number of messages in an unregulated environment, the market becomes riskier as investors assess the quality of information and it can be more difficult for new investors and for investors with less investment experience. Thus, stock message boards have the potential to spread both good and bad news and the assessment of such information requires a degree of filtration. If this is the case, then message board postings add another layer of uncertainty to investors, which in turn is likely to increase the unpredictability of share prices.

Message boards also have potential to reach investors who would otherwise remain outside of the information loop (Jones 2006). These investors, when communicating with fellow members or reading messages, are likely to be induced to revise their expectations of the firm and are likely to trade stocks. Even existing investors, when communicating with fellow investors more frequently, may update their information set and adjust their expectations about a firm. This can stimulate investors to trade more frequently. Similarly, if there has been disagreement among investors on the stock forum and if that disagreement translates into real trades, we would expect to see more trading volume as a result of message board posts.

[2] The word 'information' needs to be used with greater care as it connotes something of use or value. One needs to distil actual 'information' from the 'noise' on message board recommendations.

2.6 Knowledge Gap Analysis

The extant literature on message boards which we discussed in previous sections has shown some degree of association between message boards and share trading variables. However, there is no consensus in the literature on whether message boards predict or follow the stock market. Most of the prior studies have focused primarily on stock returns and very few studies look at other trading variables such as share price volatility, trading volume and share price liquidity. Our study revisits the relationship to the stock returns and also presents detailed studies on trading volume, volatility and share price liquidity. Like analysts making recommendations, individual investors who post messages on the discussion site can have some biases. However, it is less clear what these biases are and how the message boards contribute to market efficiency after controlling for these biases. In addition, we have no understanding of how investors' reactions to company news vary with the presence of message board discussions. Thus, in our empirical studies, we seek to shed light on these issues by addressing the following questions: (1) Do message boards have any effect on share trading variables? (2) If they do, is it a positive or negative effect? (3) What are the inherent biases in message board recommendations and do they have any investment value? (4) How do message boards change investors' reactions to unscheduled company news?

2.7 Chapter Summary

In summary, this chapter has reviewed the message board literature in order to set the research context for our empirical work examining the effect of message boards on share trading variables. The level of activity on message boards is growing rapidly among investors and discussions held on such forums are likely to influence the decisions made by individual investors. Potential economic benefits and social benefits

are two likely motivational factors that drive investors to participate on message boards. The extant message board literature has focused mainly on stock returns and we have less knowledge about how message boards contribute to other trading variables. Our research studies the contribution of message boards to market efficiency by examining variables like stock returns, trading volume, share price volatility and liquidity. Our study is also investigates the biases in investors' recommendations and how investors' reactions to company news is affected by the presence of message board discussions.

Chapter III: Research Design

The previous chapter reviewed the literature on stock message boards and discussed possible reasons why message boards do or do not contribute to stock trading activity. The chapter also identified the need to revisit the impact of message boards on the efficiency of stock markets. It identified the need to use an increased sample size and a longer study period.

This chapter describes the design of the five empirical studies we use to address the knowledge gap identified in the previous chapter. The chapter begins with a description of the data used in this study. This chapter also describes how message board recommendations are numerically coded in the studies and discusses some summary statistical data from the studies. The chapter also briefly describes the different research contexts used to address the research problem. Details of context-specific research methods and other techniques are presented separately in each of the subsequent chapters.

3.1 Data

We study over 1.7 million messages posted by more than 10,000 unique posters on the 764 largest firms (based on market capitalisation) listed on the Australian Stock Exchange as of 17 July 2009. The sample period is five years commencing from the 1 January 2004 through to the end of 2008. We began with a sample of 1,000 firms and after excluding companies which had one or more observations missing (such as book value, market value, share price, message board data etc.) we ended up with our final sample of 764 firms.

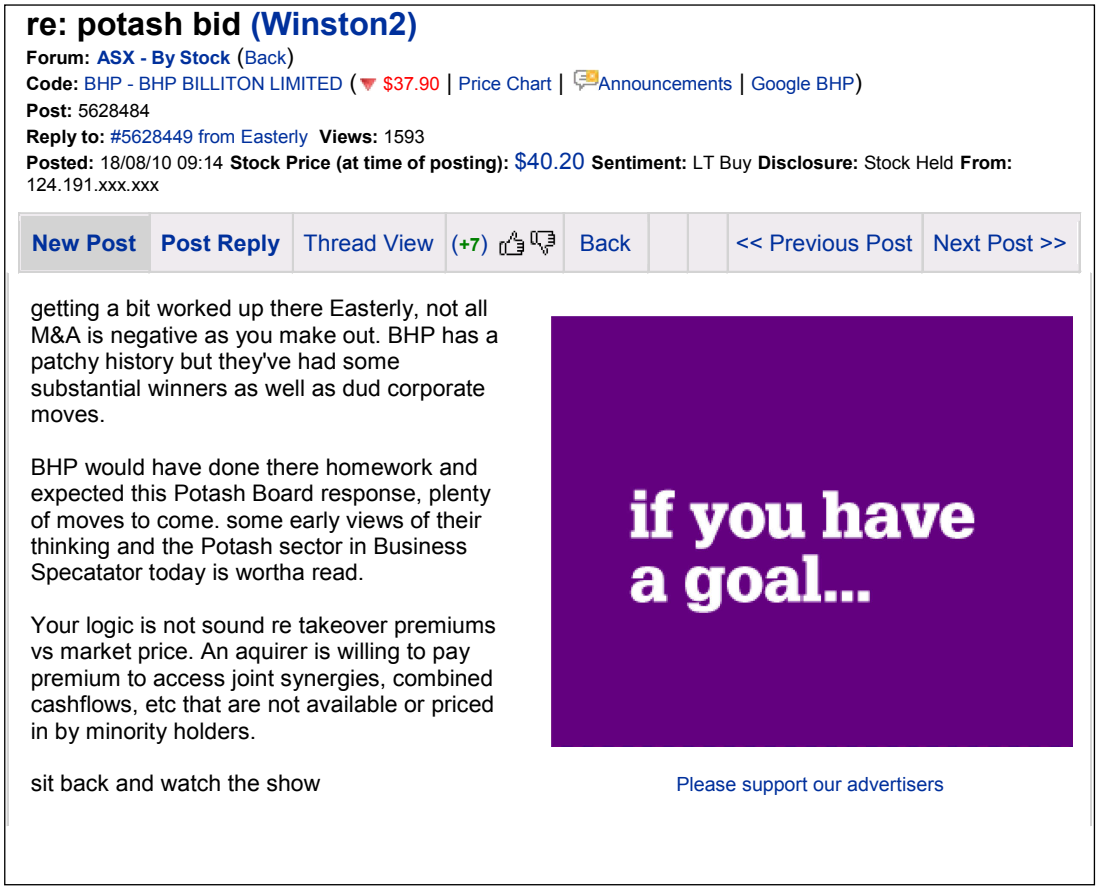
Message board data were obtained from the *HotCopper* site (www,hotcopper.com.au). *HotCopper* provided us access to an archived file on their website for each of the firms in our sample. The website provides a free forum for investors to comment on a range of topics including stocks (predominantly listed on the Australian and New Zealand stock exchanges), future contracts, and foreign currency trading. While we acknowledge that there are several other free and paid stock message boards in Australia, we selected *HotCopper* for several reasons. First, the website reports over 150,000 active members, with more than 5,000 posts per day on its website and claims to be Australia's largest stock market discussion forum (HotCopper 2011). Second, the website provides a forum for a variety of topics ranging from property investment to sport, and it attracts investors with varied interest from different quarters of the society. Third and more importantly, the format of the message box allows posters to provide a wide range of types of information such as their sentiment, and voluntary disclosure of their share ownership. In addition, two prior studies on Australian stock message boards have been based on the data collected from *HotCopper*. As such, we consider our message board dataset to be appropriate to conduct academic research in the field of stock message boards.

With the popularity of this forum, publicly listed companies are now paying more attention to the messages posted on this website than ever before. Recent evidence of this includes CuDeco, a copper mining and exploration company, taking legal case against *HotCopper* and two of its members in 2010 for allegedly making misleading and defamatory remarks against the company (Stafford 2010). The *HotCopper* message board also has a provision for company representatives of ASX or NZX listed companies, or any companies involved in finance and investment in Australia or New Zealand, to contribute to discussions on behalf of their companies. All these indicate

that the forum is being used and monitored by company directors or representatives to keep track of what is being discussed about their companies. While we acknowledge the potential for bias in that the subset of *HotCopper* discussions may not be a representative sample of all stock message board discussions, the features and popularity of the site far outweigh these potential concerns.

Figure 3.1 shows a screenshot of a message posted on *HotCopper*. Anyone can read messages but to post a message, a user needs to be registered. A message posting on *HotCopper* contains the author's nickname, the name of the forum to which the message is posted, the ASX code of stock being discussed, a subject line, the date of the post, the sentiment of the poster and voluntary disclosure of whether the poster owns the stock or not. Discussions are organised into threads that contain posts on the same topic and the posters can start their own thread, which is similar to starting a new topic. Participants can post messages at any time. Messages are archived under each stock's code and users can view the messages anytime after they have been posted.

Figure 3-1: HotCopper Message Box Snapshot



Source: HotCopper (http://hotcopper.com.au/post_single.asp?fid=1&tid=1234421&msgid=6937045),

[Accessed on 20 August 2010, 6:00PM AEST]

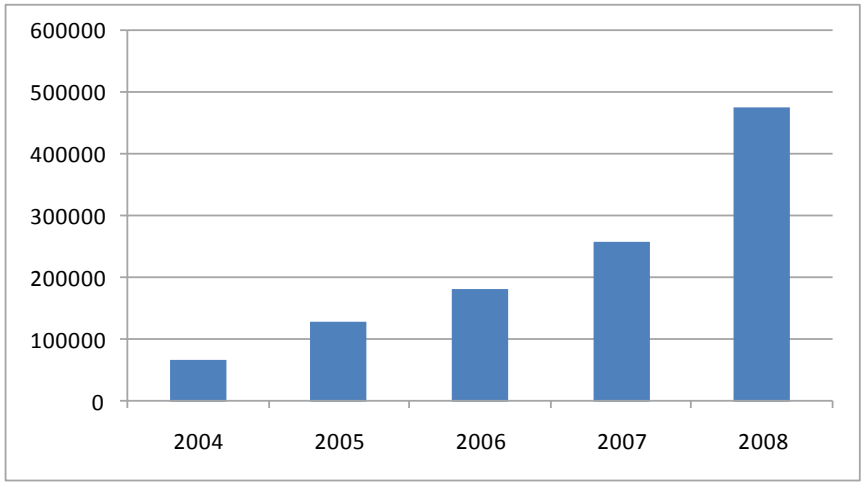
We perform simple analyses to reveal the message posting pattern for our sample firms over a five-year study period. Figure 3.2 (a) shows the total number of messages posted on our 764 sample firms each year during the five-year period. Figure 3(b) and Figure 3(c) present the average message volume for our sample firms on a monthly and a weekly basis respectively. Clearly, message board activity can be seen to increase exponentially over time. In the second half of the calendar year there are a lot of message postings, with August and November being the busiest months of the year. We also note that Sunday and Monday are quieter than other days. Posting activity gathers momentum

from Tuesday with Friday being the busiest day of the week. We also see relatively high levels of messages posted on Saturdays.

Figure 3-2: Message posting patterns

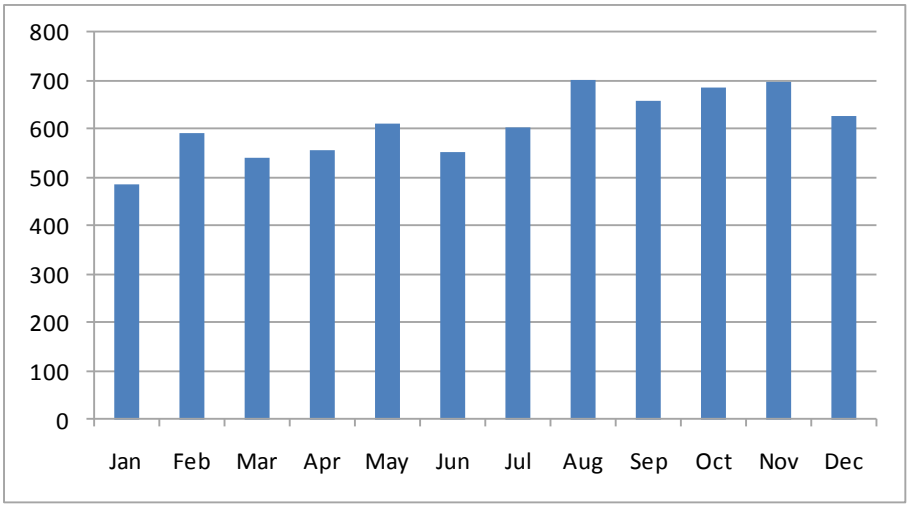
(a) Message posting by year

This figure shows the total number of messages posted for our sample firms over the five-year study period



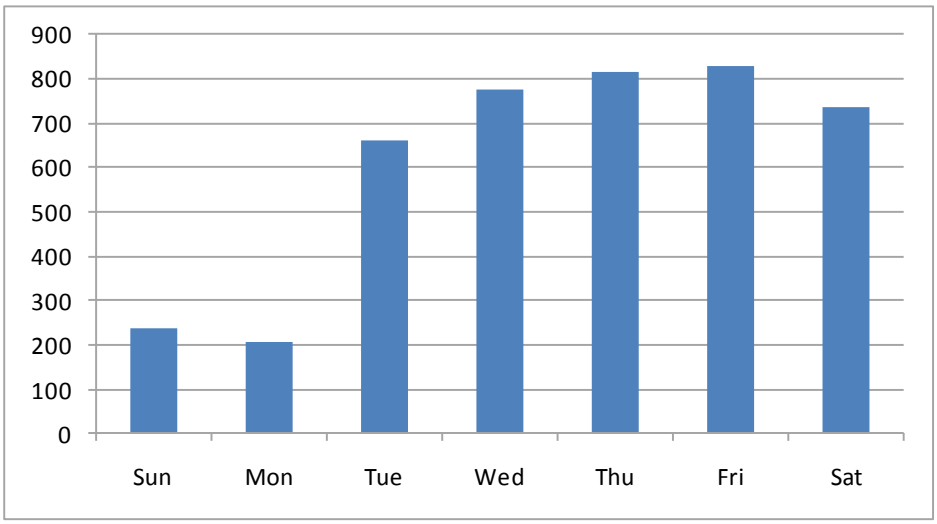
(b) Message posting by month

This figure shows the average number of messages posted for our sample firms per month over the five-year study period.



(c) Message posting by day

This figure shows the average number of messages posted for our sample firms per day over the five-year study period.



We used several financial and accounting-related data in our study. Financial and accounting data such as stock price, trading volume, market capitalisation, book value, earnings, and sales figures were downloaded from the global financial and macroeconomic database, Thomson Reuters DataStream. For calculation of stock returns, we used the return index provided by DataStream which adjusts for dividend distributions, share re-structuring and other appropriate changes in share structure. Market capitalisation and book values were also downloaded from DataStream.

Information regarding company announcements was collected from the from the Security Industry Research Centre of Asia-Pacific Limited (SIRCA), which records company news under 19 different categories such as Takeover Announcements, and Dividend Announcements. The database also identifies whether or not recorded news is price-sensitive. We used only price-sensitive announcements in our study. Data for analyst coverage is collected from I/B/E/S summary files provided by Wharton Research Data Services (WRDS).

3.2 Recommendation Measures

As shown on the screenshot, *HotCopper* allows forum participants to express their sentiments at the time of their message posting. Users can express sentiments in seven different ways: Long-term Sell, Short-term Sell, Sell, Hold, Buy, Short-term Buy and Long-term Buy. We first code these qualitative statments of recommendations with some numeric values and aggregate these numeric values to arrive at a total score on a stock for a given day. In order to aggregate this recommendation measure, we assign the following scores to each expression of sentiment as follows:

Expression of Sentiments	**Assigned Score**
Long-term Sell:	-2
Short-term sell or Sell:	-1
Hold:	0
Buy or Short-term Buy:	+1
Long-term Buy:	+2

We then compute the consensus recommendation level for each stock for any period as follows:

$$\text{Consensus Recommendation} = \frac{Net\ Score}{Total\ Number\ of\ Messages}$$

Measures of recommendation levels were compiled for each day of the period. These figures could then be used to calculate the average over any other periods when required. After computing the consensus recommendation level for each day, we calculate the recommendation changes. These changes were calculated as the difference

between the current consensus recommendation level and the consensus recommendation level at some reference point in the past. The recommendation changes we use in Chapter 7 were worked out on a monthly basis and they represent the difference between this month's recommendation level and the past months's recommendation level. Depending on the types of changes, recommendation changes were further classified into three different categories and coded numerically as below:

Recommendation Change	**Coded as**
Increases:	1
Remains same:	0.5
Decreases:	0

Recommendation changes used for the event study methodologies (Chapters 4, 5 and 6) however, were computed from daily values. These values were calculated as the difference between the current value and the average of recommendation values over the five days prior to the event day.

3.3 Summary Statistics

Table 3-1 shows a summary of statistics for our 764 sample firms and the other variables that were used in the study. The average number of messages posted about our sample firms is 1.60 per day. This shows that message board activity for a stock tend to be quiet most of the time with occasional spikes. Similarly, we have an average of 0.84 unique posters per day. This indicates that users are likely to make multiple posts. The average recommendation value was 0.16 per day. Positive values of average recommendation level suggests that message board recommendations are generally bullish in nature.

Table 3-1: Descriptive Statistics

This table presents firms' characteristics and message board descriptive statistics for the sample of 764 firms from 2004 through 2008. 'Number of messages posted' is the average number of messages on a stock averaged over five years. 'Number of unique posters' is the number of unique user posting messages on a stock on a day. 'Recommendation values' is the average aggregated score for the recommendations made on message board on each day. 'Market capitalisation' and 'Book value' were computed as at the end of the previous month when the announcement was made. 'Past month return' is the previous month's log(1+r) stock return. 'Volatility' is the realised volatility, measured using daily data without Newey-West corrections over the previous 20 days.

Variable	Mean	Std. Dev.	25th Percentile	Median	75th Percentile
Message Board Characteristics					
Number of messages posted (per company per day)	1.60	4.04	0.03	0.25	1.31
Number of unique posters (per company per day)	0.84	1.73	0.02	0.19	0.89
Recommendation Value (per company per day)	0.16	0.35	0.00	0.02	0.19
Sample firm Characteristics					
Market capitalisation (in millions AU$)	1377.93	447.15	1036.26	1335.51	1702.27
Book Value (in millions AU$)	368.65	108.16	307.31	366.18	439.65
Othe variables used in the study					
20-day realised volatility	55.92%	28.56%	37.73%	49.38%	66.09%
Past month Return	-0.39%	14.51%	-6.24%	-0.05%	6.09%

The average value of market capitalisation is AU$1337.93 million with the average book value being AU$368.65 millions. Average values for 20-day realised volatilities and past month returns are 55.29% and -0.39% respectively.

3.4 Research Methods

To address the research problem, we conducted different empirical tests in our research studies. Detailed methods are discussed in the relevant chapters. In this chapter, we present the techniques that are used across several chapters. For example, Chapters 4, 5 and 6 examine the impact of message boards on trading variables under

normal and abnormal levels of message posting activity. Days with abnormal message-posting activity are idenfied using some pre-set rules and this technique is common for the next three chapters. We present the criteria used to identify event days below.

3.4.1 Event Study Methodologies

Since part of our study focuses on the impact of abnormal message board activity on share trading variables, we set up an event study methodology to examine the behaviour of trading variables around periods of high message board postings[3]. There is no consensus as to how days with high-message-posting levels should be defined but we base our methodology on a prior study but we slightly refine the criteria. Following Tumarkin and Whitelaw (2001), we use five-day moving average and standard deviation techniques to identify the event days. However, selecting events based on the increase in time-series volume alone may not be effective. For example, when all the stocks experience huge increases in message volume as a result of some particular market event, this technique may not correctly identify which days are event days. Acknowledging this limitation, we introduced one more criterion: on a list of stock ranked according to the number of messages which related to each one, the stock had to be in the top decile (calculated daily for all the stocks) for that stock to be classified as experiencing an event day. This addressed cross-sectional variations in message posts to some extent. We also required our samples to have at least ten or more messages on the event day, and they had to be submitted by at least three unique users. To some extent this improved our chances of identifying event days, because it eliminated the inclusion of situations where a single user made a large number of posts. It also ensured that abnormal numbers of posts were not made by a handful of investors.

[3] Brown and Warner (1985) and Campbell, Lo and MacKinlay (1997) present details of these methods.

For each event, we computed the five-day moving average and the standard deviation of message volume over the previous five days and determined the top 10% when all stock in the sample were ranked according to the number of daily messages which were about them. Thus, our event days are defined as days with the number of message postings satisfying the following three conditions:

(i) message volume exceeded the five-day moving average plus two standard deviations (i.e. message volume > 5-d MA + 2 x STD);

For each event, the moving average and standard deviation of daily message volume was calculated over the previous five days. When the message volume on a day was greater than 5-day moving average plus twice the standard deviation, we classify this as the event day.

(ii) daily message volume is in the top decile across the 764 firms; and

(iii) there are at least 10 messages on the event day by at least three unique users.

A total of 9,982 event days were identified satisfying all the conditions listed above. Just as it can be associated with an increased recommendation level for a stock, an abnormal surge in message posting activity can also be accompanied by recommendation changes. Consensus recommendations can increase, decrease or remain the same on the event days relative to previous five days. As such, event days are further categorised according to changes in investors' recommendations – Positive Changes (i.e. recommendation values increase compared to the average of the previous five days), No Changes (i.e. recommendation values remain the same as the average of the previous five days) and Negative Changes (i.e. recommendation values decrease

compared to the average of the previous five days). We use the raw change in weighted opinion metrics to determine the strength of opinion and recommendation changes are computed as the difference between daily recommendations and the average recommendation over the previous five days. We found 8,141 positive event days (i.e. days for which the daily consensus recommendation level was greater than five-day moving average), 757 neutral event days (i.e. days for which the daily consensus recommendation level was equal to the five-day moving average) and 1084 negative event days (i.e. days for which the daily consensus recommendation level was lower than the five-day moving average).

From our message board dataset, we could also obtain information about the number of users active on any day. A simple correlation, as shown in Table 3-2 below, shows that the correlation between message volume and the number of unique users is positive and very high (+0.935).

Table 3-2: Correlation among Message Board Variables

	Recommendation	User	Message
Recommendation	1.000	0.658	0.556
Unique User Number	0.658	1.000	0.935
Message Volume	0.556	0.935	1.000

To ensure the robustness of our event-study results, we identified event days based on unique user numbers and examined trading variables in the same fashion. Given the positive correlation between message volume and user number, we expect that event days based on numbers of users should also produce similar results. Details of methods used in measuring return, trading volume, liquidity and volatility are discussed in subsequent chapters.

3.5 Research Contexts

We studied the financial relevance of message board recommendations in five different contexts. While empirical results and discussions are presented separately in the following chapters, a brief description of each of the five studies undertaken in this research is presented below:

3.5.1 Message Board and Trading Variables (Chapters 4, 5 and 6)

We first look at the impact of message boards on share trading variables. We examine the relationship under normal and abnormal message board activities. Chapter 4 reports the impacts of message boards on stock returns whereas Chapter 5 and Chapter 6 report message board impact on volatility, and trading volume and liquidity respectively. In addition to event study methodologies, we used portfolio analysis methods and series of regression models in these chapters to examine the relationships between message boards and trading variables.

3.5.2 Message Board Recommendations and Future Returns (Chapter 7)

As discussed in previous chapters, it can be seen that the number of participants and the message board activity increased every year. The level of attention each firm gets from message board participants may not always be equal and level of interest can change over time. It is interesting to know whether investors exhibit any preference in message board recommendations. There are several studies (e.g. Azzi & Bird (2005), Jagadeesh & Titman (2002)) examining analysts' preferences for covering stocks in their recommendations. Our study allows us to investigate whether message board participants exhibit similar preferences. Similar to Azzi & Bird (2005) on analysts' recommendations, we examine if message board recommendations at consensus level

and changes of recommendations provide any useful input into investment decisions. We also examine how these results are affected by market upturn and market downturn periods.

3.5.3 Stock Message Boards and Investors' Reactions to Company News

There is growing evidence in finance literature of activity on stock message boards and the stock market. In this study, we observe the stock message board activity around price-sensitive company announcements and examine whether the message board activity causes systematic variations in the reaction of stock prices to company news. This study is also related to effects of message board activity on firms' informational environments.

3.6 Chapter Summary

This chapter provided detailed information about the data we used in our study and the techniques we used to convert qualitative data into numerical measures. The chapter also described five different contexts used in our research to determine financial relevance of message board recommendations. Details of the methods used and discussions of empirical results are presented in the following chapters.

Chapter IV: Message Boards and Stock Returns

4.1 Introduction

The previous chapter discussed the research data and the methods used to examine the contribution of message boards to market efficiency. In this chapter, we examine the relationship between message board postings and excess stock returns to evaluate whether the discussions on message boards provide useful information to participants. In doing this, we consider message volume, consensus recommendations and recommendation change as measures of information and we use market-adjusted return as our measure of excess returns.

Potential economic gain is one of the motivational factors that attract investors to message board discussions. From the insights they get from message board recommendations, investors may be tempted to make investment decisions. With the increasing use of message boards by financial market participants in recent years, posts on message boards are attracting other stakeholders (such as company directors, representative) into the debate as well. The use and the impact of message boards on the investment community has increased considerably in recent years to the point where events arising from message board discussions are reported in the mainstream media. For example, court cases involving *HotCoppe*r (Stafford 2010) show how discussions held on virtual communities can spill over to the real world. In an attempt to warn users of manipulative posts, regulators and even message board providers are making it very clear that investors should be cautious before acting on any of these recommendations. The effectiveness of such warnings is unclear but with the growing number of message board participants, the influence of these forums can be expected to increase over time.

The increasing activity and influence of message boards have attracted academics to consider whether the social media have any influence on improving the efficiency of capital markets. Research in this area to date is embryonic. Through this thesis, we are attempting to build on previous works by examining whether message board posts provide any informational value to investors. We focus on the main issue of message board activity: can investors benefit from message board recommendations? By studying the return consequences of message board recommendations, we shed some light on whether investors can profit from message board participation.

We present empirical tests that examine the usefulness of stock recommendations at normal and abnormally high levels of message board activity. Using message board data from 2004 to 2008 obtained from *HotCopper* for 764 large firms (based on market capitalisation) listed on Australian Securities Exchange (ASX) we find evidence that the relationship between message board activity and stock returns is two-way (i.e. abnormal stock returns attract more posts, which in turn are followed by higher returns and so on). Abnormally high message volume predicts negative returns on the next day and this suggests that investors are likely to discuss the stocks heavily on the forum towards the end of share price momentum cycle.

Empirical data presented in this chapter makes a primary contribution to our understanding of message board and stock returns in two main areas. First, we provide results from a large sample (764 firms listed on the ASX) examined over a five-year period. To the best of our knowledge, prior to our study the message board literature has not used as many firms in their samples and they have not involved as long a study period as we have employed in this study. By expanding the sample size, we expect the results to be more representative. We acknowledge that message board activity is a very dynamic and ever-changing phenomenon. As the number of participants grows, the

influence of message boards on investors' decision making processes can also change over time. By using time-series data over longer periods, we expect to address some of these changes. Second, we examine the relationship between message boards and stock returns under normal and abnormal levels of message board activity. When a stock is discussed at an abnormally high level, it has the potential to be recognised among the investor community, thereby attracting new investors. The impact on share prices in these circumstances can be more obvious than when the stock is not on the 'hot list' of discussion. Recognising this, we conducted event study tests on the dataset.

The remainder of this chapter is organised as follows. Section 2 briefly reviews the existing literature. Section 3 describes the research data, and discusses the descriptive statistics and variables used in this study. Section 4 explains the research methods used in this study. Section 5 discusses the empirical results of the tests. Section 6 concludes our findings.

4.2 Literature Review

Potential economic benefit is a major motivational factor for investors' participation in stock message board activity. Despite contradictory findings on the economic usefulness of message board recommendations, investors' participation in such discussions is growing. We presented some chronological evidence of growth in our first chapter. Even our sample data described in Chapter 3 shows an exponential growth in message board activity over time. We have provided an overview in Chapter 2 of why message board postings are likely to have an influence on stock trading variables such as returns. The potential for generating concerted trade, originating and spreading rumours, manipulation attempts, the ability to induce new investors to trade were mentioned as potential reasons for the influence of message boards on share prices and

other trading variables such as trading volume and volatility. In this section, we review some specific literature that relates to the effects of message boards on stock returns.

When a message is posted on a discussion board, its content has an implicit or explicit statement of sentiment. Posts on virtual communities can in fact represent their sentiment on the stock being discussed. This sentiment, however, may change over time. Several studies such as Baker and Wurgler (2006), Livnat and Petrovits (2009), and Barber, Odean and Zhu (2009) document the mutual influence of stock returns and investor sentiment. The extant body of literature on investor sentiment shows the use of a wide array of investor sentiment measures but the theory about whether investor sentiment may contribute to the market pricing is still evolving. For investor sentiment to influence share price equilibrium, there needs to be a consensus within a group of investors. Since message boards bring different investors into a single platform, one can think of sentiments expressed on a message board as the way a group of investors thinks about the future development of stock prices. As such, the sentiment we obtain from message board data represents that of a group of investors and if there is a correlation of sentiment within the group, we can expect it to influence share prices.

There are different types of investors who engage in message board discussions, including individual investors and noise traders (Koski, Rice & Tarhouni 2004). Studies on noise traders such as Shleifer and Summers (1990), DeLong et al. (1990), DeLong et al.(1991), and Shleifer and Vishny (1997) propose a theory that noise traders may influence prices even in markets where some investors are well informed, because informed traders face risks that are likely to limit their actions. For example, there may be mispricing of stock as a result of intensified investors' sentiment but informed traders may not be able to sell their shares because the market may be illiquid. If message board users are a proxy for noise traders as used in Koski, Rice and Tarhouni

(2004) and in Zhang (2010), then message board postings should have the potential to influence the share prices.

Given that online message boards are a relatively unregulated information environment where users can use nick names, it is possible to use them to initiate and spread rumours about firms. The quality and values of messages posted on discussion sites are always questioned by observers. For example, when an existing shareholder of a company posts something on the board, the content and sentiment expressed cannot be free from ownership bias. It can be considered that information on a message board may contain significant noise, contradictory recommendations, rumours, and even manipulation attempts. All these information types can have an influence on individual investors, especially when they are relatively uninformed and inexperienced investors. Two separate studies, one in Australia and another in the US document that takeover rumours originating from online forums can generate abnormal excess returns (Clarksona, Joyceb & Tutticci, 2006; Hallett, 2007). Another study by Delort et al. (2009) using *HotCopper* data suggests that manipulation attempts by investors are positively related to abnormal returns despite the moderation of messages. While stock markets always tend to have rumours and speculation, these studies relating to rumours on message boards suggest that internet discussion sites can be an easy way to propagate these rumours and so message boards have the potential to influence share prices.

Message boards are advanced applications of the internet that bring investors closer and are considered to be an addition to the array of online social interaction tools. Investors can share, exchange and debate any piece of information. Investors can be seen analysing complex company reports, earning announcements, progress reports and development proposals in their messages. For investors at the beginning of their careers

and those who have less investment experience, such discussion on forums may sound fascinating and may form the basis for their investment decisions. For example, progress reports released by companies are reviewed by many investors who may have different perspectives. Readers of these message board posts may just read the comments and form a view about this news rather than use their own analytical skills. If such responses are translated into stock trading, one can expect the message boards to have impact on share prices.

So far however, studies of message boards have reported mixed results on the relationship between forum activity and stock returns. Wysocki (1999) finds that the volume of messages on stock forums gives an indication of the returns on the next day. The study supports the idea that messages posted are not just noise but can collectively influence share prices. Another related study by Sabherwal, Sarkar and Zhang (2008) analyses the most discussed stocks on stock message boards and finds that message board variables are contemporaneously related to stock returns and have predictive power over one-day returns. However, Antweiler and Frank (2004) examined 45 companies from the Dow Jones Industrial Average and the Dow Jones Internet Index and find that increased numbers of posts predicted negative returns on the next day.

Another side of the argument about message board impact on stock return supports the efficiency of stock markets. Although the information gap between informed and uninformed investors may have been reduced due to the speed of information communication that message boards offer to investors (Levitt & Dubner 2005), message boards may have no impact on share prices. A study by Tumarkin and Whitelaw (2001) on internet service sector stocks reports that while there is some contemporaneous relationship between message board variables and stock returns, there is no evidence to suggest any predictive power over stock returns. They also studied the

causation of the relationships involved and report that stock market Granger-causes the message board activity, not the other way around. A clinical study conducted on message boards by Das, Martínez Jerez and Tufano (2005) confirms market efficiency and finds that stock returns drive investor sentiment.

Thus, based on the discussions presented above, there is mixed evidence about whether message boards do or do not have an influence on returns. Prior studies on message boards report contradictory findings and no consensus has been reached yet on the impact and nature of impact of message boards on stock returns. As such, it would be interesting to revisit the question of whether or not message board posts have an impact on share prices.

4.3 Research Data

We obtained message board data from *HotCopper*. A total of 764 firms were studied over a period of five years, commencing from 1 January 2004. Share price related data were downloaded from DataStream. Descriptions of data sources and details of recommendation measure calculations are described in 'Chapter 3 – Research Design'.

4.4 Research Methods

We conducted three types of tests on the relationship between message board activity and stock returns. First, we ran time series Granger-causality regressions to test whether message board recommendations affect stock returns. This allowed us to investigate generic time-series relationships between the message board and stock returns. Second, we used portfolio analysis methods in which we double-sorted the portfolios based on message volume and recommendation changes. Returns were then measured over different holding periods and the differences between these portfolio

returns were examined. Finally, we performed event study analysis and examined stock returns around the days with abnormally high message board activity. These returns around event days were further analysed with a series of regressions models.

4.4.1 Cross-sectional and Granger Causality Regression Tests

The existing literature gives conflicting reports about the association between message board activity and stock returns, especially in terms of causation effects between these two variables. Vector Auto-regression (VAR) Analysis of time-series data undertaken by Tumarkin and Whitelaw (2001) suggests that causality appears to run from the market to the financial forums. They indicate that changes in stock markets can result in more postings on message boards but not the other way around. Message board participants can take the lead from any sources to set its agenda for discussion and recent price action in the stock market may be one of many sources. An unusual change in share prices can become an interesting topic for message board participants and can generate a lot of discussion. These posts then have the potential to cause further changes in share price. As such, any claim that there is a unidirectional relationship between message boards and the stock market may not be appropriate and this is something we test in our study. We examine the concept of Granger causality (Granger 1969) to study causality in the relationships between message board activity and stock returns. The Granger causality test allows us to examine the causal effect of one variable on another and the results of this test imply chronological ordering of movements in the series to interpret if there are any lead-lag interactions between the series.

For each of our sample firms, we run following time-series regressions:

$$R_t = \alpha + \beta_1 R_{t-1} + \beta_2 R_{t-2} + \beta_3 MB_{t-1} + \beta_4 MB_{t-2} + \varepsilon_t \quad \text{.....(4.1)}$$

$$MB_t = \theta + \gamma_1 MB_{t-1} + \gamma_2 MB_{t-2} + \gamma_3 R_{t-1} + \gamma_4 R_{t-2} + \delta_t \quad \text{.....(4.2)}$$

where R is a return measure, MB is a particular message board measure (message volume, recommendation etc.) and ε and δ are error terms. Subscripts *t-2, t-1,* and *t* denote trading days as the model uses the lag length of 2. Regression coefficients β_1, γ_1, β_2, and γ_2 control for any time series autocorrelation of the dependent variable whereas coefficients β_3, β_4, γ_3 and γ_4 measure the effects of past values of message board activity and stock returns. Hence, an F-test of the restriction that $\beta_3=\beta_4=0$ is used to test whether the message board influences stock returns. Similarly, the test for whether stock returns influence message board activity is an F-test of the restriction that $\gamma_3=\gamma_4=0$.

4.4.2 Portfolio Analysis Method

While changes in message volume is a good measure to identify abnormal message posting activity, interpretations based on message volume alone may not be adequate to capture the information contained in these posts. For example, abnormal increases in message volume may result from both good and bad circumstances of a company. Looking at the message volume alone, one cannot distinguish whether the spike in message volume is for good reasons. As such, in conjunction with message volume, we also include recommendation measures in portfolio formation. We convert the sentiment measures which we obtain from our dataset into numeric values as described in Chapter 3. We then use these consensus recommendations and changes in recommendations as proxies for message board discussions. When message volume is combined with recommendations (and recommendation changes), we expect that a reasonable assumption about the nature of the posts can be made. For example, high message volume with high recommendations may indicate positive messages while high

message volumes with negative recommendations may indicate negative messages. Accordingly, we expect the impact of these two states on stock returns to be different. To examine this, we examine the performance of stock portfolios formed by double sorting the message volume and recommendation level (or changes) measured over different time horizons.

For the portfolio construction, we first categorise the stocks into high, low and medium terciles based on daily recommendation values. Within each tercile, we further classify the stocks into high, medium and low terciles based on message volume (and the number of unique users). As shown in Table 4-1 below, we constructed a total of nine different portfolios representing each possible combination of message volume and recommendation changes. The performances of these portfolios are then measured over different study horizons and the significance of these abnormal returns is tested by using t-statistics.

Table 4-1: Portfolio Formation Method

Recommendation ↓	No. Of Unique Users (No. of Message) -->		
	Low	Medium	High
Low	Portfolio 1	Portfolio 4	Portfolio 7
Medium	Portfolio 2	Portfolio 5	Portfolio 8
High	Portfolio 3	Portfolio 6	Portfolio 9

High message volume with high recommendation values are expected to have a different impact on share price movements than high message volume with negative low recommendation values. As such, we expected the future returns of portfolio 9 (high message with high recommendation) to be greater than that those of portfolio 7 (high message with low recommendation). Similarly, future returns on portfolios 7, 8, and 9 were expected to be greater than those of portfolios 1, 2 and 3 respectively. We

present statistical tests of these differences in the empirical results section of this chapter.

4.4.3 Event Study for Abnormal Message Board Activity

The methods discussed in the previous two sub-sections investigated the relationship of message boards and stock returns in general. For many stocks, message board activity tends to be quiet for a long period of time followed by a sudden rise in the number of messages. This abnormally high message board activity can represent something unusual about the stock. This also offers an opportunity to study whether these unusual events provide any informational value to investors. To study this, we used event study methodology and examined abnormal returns around the days with abnormally high message board activity. Detailed discussions on event study methodologies are presented in 'Chapter 3-Research Design'.

We examined the stock returns over an 11-day (i.e. t-5 to t+5) event window and analysed how much of these abnormal returns were contributed by message board postings. Daily return indexes obtained from DataStream were used to calculate daily returns on each stock and the All Ordinaries index was used as the benchmark (or market) index. Abnormal returns were calculated as the difference between the actual return and the benchmark return and were computed as follows:

Abnormal Return, $\mathbf{AR_{i,t} = R_{i,t} - R_{m,t}}$ .....(4.3)

where $R_{i,t}$ is the return on stock *i* on day *t* and $R_{m,t}$ is the market return on day *t*. We also examined cumulative abnormal return over 41-days (i.e. *t-20* to *t+20*) around the event date. Cumulative abnormal returns (CAR) were calculated as the sum of the abnormal returns for each day in the event window as below:

$$\mathbf{CAR_i} = \sum \mathbf{AR_{i,t}}$$

In an efficient market environment, message board postings should have no impact on stock returns. Inferences about the CAR can be drawn by using a t-test statistic, where:

$$\mathbf{t} = \frac{\mathbf{CAR_i}}{\left(\sigma_i / \sqrt{n}\right)}$$

where, σ_i is the standard error of the distribution and $\mathbf{n}$ is the number of days in the event window. After estimating the abnormal returns ($AR_{i,t}$), we performed a series of regression analysis to determine how much of these abnormal returns was contributed by message boards and how much of these returns was explained by other variables. Again, message volume, consensus recommendation, and recommendation changes were used as proxies of message board activity and the regressions were run in two different ways: (1) using message board variables only as the explanatory variables and (2) using message board variables and other control variables such as market size and book-to-market ratio.

For regressions with message board variables only, we used the following equations:

Model 1:

$$\mathbf{AR_{i,t}} = \alpha + \beta_1 \mathbf{Message}_{1,t} + \varepsilon_{1,t} \quad \text{.....(4.3)}$$

Model 2:

$$\mathbf{AR_{i,t}} = \alpha + \beta_1 \mathbf{Recommendation}_{1,t} + \varepsilon_{1,t} \quad \text{.....(4.4)}$$

Model 3:

$$\mathbf{AR_{i,t}} = \alpha + \beta_1 \mathbf{RecommendationChange}_{1,t} + \varepsilon_{1,t} \quad \text{.....(4.5)}$$

Model 4:

$$\mathbf{AR_{i,t}} = \alpha + \beta_1 \mathbf{Message_{i,t}} + \beta_2 \mathbf{Recommendation}_{1,t} + \varepsilon_{1,t} \quad \text{.....(4.6)}$$

Model 5:

$$\mathbf{AR_{i,t}} = \alpha + \beta_1 \mathbf{Message_{i,t}} + \beta_2 \mathbf{RecommendationChange}_{1,t} + \varepsilon_{1,t} \quad \text{.....(4.7)}$$

The first three equations were used to study the effects of message board proxies separately while the last two equations look at the joint effects of message board variables. As we discussed earlier, we cannot rely on message volume alone to determine the nature of events as both positive and negative events can attract high level of postings. However, we also noted a positive correlation between message volume and recommendation values, indicating that most of the message posts tended to be positive.

Recommendation values calculated by using the method described in Chapter 3 represent consensus recommendation of investors for the day. If the market was not efficient, we might expect to see these recommendation values influencing share prices. Another important message board variable we used in our study was recommendation change. Recommendation change on event day relative to the previous five days indicated the change in investor recommendation. If message board had any effect, upgrades in recommendations should have been positively related to abnormal stock returns.

In addition to regressions with message board variables, we controlled for several firm characteristics that are considered to be important in describing abnormal returns for a stock. Although prior studies such as Wysocki (1999) and Sabherwal, Sarkar and Zhang (2008) have some contradictory results as to what attracts investors to post messages on stock forums, they both indicate that some of the abnormal returns are explained by firm characteristics. To control for these firm characteristics, we re-ran the above regressions with additional variables and the equations are expressed below:

For regressions with full model,

Model-1:

$$\mathbf{AR_{i,t} = \alpha + \beta_1 Message_{i,t} + \beta_4 News_{i,t} + \beta_5 Size_{i,t} + \beta_6\ BM\ ratio_{1,t} + \beta_7 Momentum_{1,t} + \varepsilon_{1,t}}$$

.....(4.8)

Model-2:

$$\mathbf{AR_{i,t} = \alpha + \beta_1 Recommendation_{i,t} + \beta_4 News_{i,t} + \beta_5 Size_{i,t} + \beta_6\ BM\ ratio_{1,t} + \beta_7 Momentum_{1,t} + \varepsilon_{1,t}}$$

.....(4.9)

Model-3:

$$\mathbf{AR_{i,t} = \alpha + \beta_1 RecommendationChange_{i,t} + \beta_4 News_{i,t} + \beta_5 Size_{i,t} + \beta_6\ BM\ ratio_{1,t} + \beta_7 Momentum_{1,t} + \varepsilon_{1,t}}$$

.....(4.10)

Model-4:

$$\mathbf{AR_{i,t} = \alpha + \beta_1 Message_{i,t} + \beta_2 Recommendation_{i,t} + \beta_3 News_{i,t} + \beta_4 Size_{i,t} + \beta_5\ BM\ ratio_{1,t} + \beta_6 Momentum_{1,t} + \varepsilon_{1,t}}$$

.....(4.11)

Model-5:

$$\mathbf{AR_{i,t} = \alpha + \beta_1 Message_{i,t} + \beta_2 RecommendationChange_{i,t} + \beta_3 News_{i,t} + \beta_4 Size_{i,t} + \beta_5\ BM\ ratio_{1,t} + \beta_6 Momentum_{1,t} + \varepsilon_{1,t}}$$

.....(4.12)

where:

$AR_{i,t}$ = Excess returns on *t-2, t-1, t, t+1* and *t+2*, regressed separately

'Message' = log of one plus message volume on event day.

'Recommendation' = the consensus daily recommendation level on event day.

'RecommendationChange' = the difference between consensus recommendation on event day and five-day moving average of recommendation prior to event day

'News' = dummy variable that assumes a value of 1 if there is any price-sensitive company news in *'t-2'* to *'t'*, with *'t'* being the event day.

'Size' = log of market capitalisation of sample firms.

'BM Ratio' = ratio of book value to market value of the sample firms.

'Momentum' = average return on the stock over last 20-days (i.e. from *'t-20'* to *'t-1'*).

We used price-sensitive company news in our regression models as one of the control variables. News events play an important role in changing investors' prior beliefs and so the adjustments they make to future expectations. In efficient markets, these news releases should have no effect on share prices. We assigned a dummy variable of 1 if there was any price-sensitive news between't-*2'* to *'t'* but did not categorise whether the news was positive, negative or neutral. We then measured the nature and magnitude of the impact on share prices made by these news events.

We also controlled for firm size, book-to-market ratio and momentum in share prices. Smaller and growth firms (i.e. the firms with lower book-to-market ratios) can be considered to have high message board followings as these firms are favoured by investors (Sabherwal, Sarkar & Zhang 2008). These firms tend to be at earlier stages of their business cycles and assessment of available information on these stocks may be difficult. As a result, these stocks are expected to have good followings on message boards. Further, issues with volatility and illiquidity of share prices can be higher in these firms than in other large stocks. In order to compensate for these factors, investors seek higher returns than they do from less risky stocks.

Another variable we controlled for in our analysis was share price momentum. There are several studies (see Barberris, Shleifer & Vishny (1998), Daniel, Hirshleifer & Subrahmanyam (1998), Hong & Stein (1999), Jagadeesh & Titman (2002)) in support of momentum strategy, which is based on investors' behavioural biases. Momentum in share price movement can attract new investors and also increase followers on message boards. Consistent with previous studies on momentum, we expected momentum in share prices to have a positive association with stock returns.

4.5 Empirical Results

4.5.1 General Relationship between Message Board and Stock Returns

As a first check on the general relationship between our message board proxy and stock returns, we studied the time series correlation between daily measures of stock returns and message board variables. Table 4-2 reports these correlation coefficients. Correlations are all positive and the degree of correlations is stronger for message volume than that for recommendation level. Similarly, recommendation and recommendation changes have similar levels of correlation (0.066 and 0.069) with returns. Thus, we observe a positive correlation between stock returns and message board variables but the strength and causation of the relationships is not clear from this analysis.

Table 4-2: Correlation between Stock Returns and Message Board Proxies

This table reports Pearson's Correlation Coefficients between stock returns and message board variables used in the study. 'Message Volume' is log of 1 plus the number of messages posted on the event day. 'Recommendation' is the consensus daily recommendation level on event day. 'Recommendation Change' is the difference between event day consensus recommendation and the average of recommendation over 5 days prior to the event.

	Recommendation	Recommendation Change	Message volume	Return
Recommendation	1.000	0.469	0.840	0.066
Recommendation Change	0.469	1.000	0.348	0.069
Message volume	0.840	0.348	1.000	0.072
Return	0.066	0.069	0.072	1.000

In an attempt to test the strength of this positive correlation, we ran a cross-sectional regression analysis. With stock returns as a dependent variable, message board variables were regressed separately and the results are presented in Table 4-3.

Table 4-3: Cross-sectional Regressions between Message Board and Stock Return

This table reports the results of cross-sectional regressions between message board variables and stock returns. Stock Return is used a dependent variable. Reported results are the coefficients for contemporaneous relationships.

	(1)	(2)	(3)
Intercept	-0.001 ***	-0.001 ***	0.000 ***
Message volume	0.003 ***		
Recommendation		0.006 ***	
Recommendation Change			0.007 ***
R-squared	0.003	0.003	0.005
Observations	679853	679373	652824
F-Test	2189.323 ***	1956.010 ***	3147.504 ***

*,** and *** are statistically significant at 10%,5% and 1% level of significance

We found that regression coefficients of message board proxies ranged from 0.003 to 0.007, suggesting a positive relationship between stock returns and message boards. The results are significant at the 1% level. We should be cautious in interpreting this regression result because while we observed a strong association between message board variables and stock return, the causation effect is not clear.

In order to see if there is Granger-causation in addition to the contemporaneous relationship, we performed Granger Causality Time-series Regression Tests and the results of these tests are reported in Table 4-4.

Table 4-4: Granger-Causality Time-series Regression Tests

Results of tests of the following time series regressions were run separately for each of the 764 firms:

$$R_t = \alpha + \beta_1 R_{t-1} + \beta_2 R_{t-2} + \beta_3 MB_{t-1} + \beta_4 MB_{t-2} + \varepsilon_t$$

$$MB_t = \theta + \gamma_1 MB_{t-1} + \gamma_2 MB_{t-2} + \gamma_3 R_{t-1} + \gamma_4 R_{t-2} + \delta_t$$

where R is Stock Returns and MB is a particular message board measure. Each message board measure is regressed separately with stock returns. 'Message Volume' is log of 1 plus the number of messages posted on the event day. 'Recommendation' is the consensus daily recommendation level on event day. 'Recommendation Change' is the difference between event day consensus recommendation and the average of recommendation over 5 days prior to the event. F-statistics are computed to test the restriction that both the coefficients β3 and β4 equal 0, or that both γ3 and γ4 equal zero.

Dependent variable: Return			
Excluded	Chi-sq	df	Prob.
Messaeg Volume	158.585	2.000	0.000
All	158.585	2.000	0.000
Dependent variable: Message Volume			
Excluded	Chi-sq	df	Prob.
Return	630.349	2.000	0.000
All	630.349	2.000	0.000
Dependent variable: Return			
Excluded	Chi-sq	df	Prob.
Recommendation	159.895	2.000	0.000
All	159.895	2.000	0.000
Dependent variable: Recommendation			
Excluded	Chi-sq	df	Prob.
Return	525.643	2.000	0.000
All	525.643	2.000	0.000
Dependent variable: Return			
Excluded	Chi-sq	df	Prob.
Recommendation Change	223.311	2.000	0.000
All	223.311	2.000	0.000
Dependent variable: Recommendation Change			
Excluded	Chi-sq	df	Prob.
Return	89.013	2.000	0.000
All	89.013	2.000	0.000

The results reported in Table 4-4 indicate that message boards Granger-cause stock returns but stock returns also Granger-cause message board variables at conventional significance levels. If these variables do not cause each other, we could expect to see the coefficients (please see the equation at the start of the table) $\beta 3=\beta 4=0$ and $\gamma 3= \gamma 4=0$. However, this expectation is rejected at the 1% level in all regressions. These results suggest that there may be a two-way relationship between message boards and stock returns. These results are in contrast to the current body of literature on message boards that focus on whether the message board predicts or reflects the stock market. For example, Tumarkin and Whitelaw (2001) suggest that market activities cause the stock forum discussions whereas Sabherwal, Sarkar and Zhang (2008) find message board recommendations predicting next day return. Our evidence suggests that the relationship between message board variables and stock returns is likely to be two-way. The most likely reason for these contradicting results may have come from the difference in the sample sizes and the lengths of the study periods used. Tumarkin and Whitelaw's (2001) sample included 181,633 messages posted from April 1999 to February 2000 on US-listed internet stocks and Sabherwal, Sarkar and Zhang's (2008) sample included 160,000 messages posted on US stocks between July 2005 and July 2006. We explicitly analysed 764 large firms listed on the Australian Stock Exchange over a five-year period (i.e. from 2004 to 2008) thereby examining more than 1.7 million messages.

Overall, these results suggest that message boards Granger-cause stock returns, which then Granger-causes message board activity. The relationships between message board recommendations and stock returns appear to be two-way.

4.5.2 Stock Returns with Message Volume and Recommendation

The results we present in the previous section are based on time-series relationships between message board recommendations and stock returns. We have three different proxies for message board activity and we studied the effect of each of them separately. In time-series datasets, we can have variations in message volume and recommendation level (i.e. changes to recommendation levels). We can have instances when higher message volume is associated with higher or lower recommendation values and the implications for share prices may be different in each case. In order to examine the impact when these two variables (message volume and recommendation value) act together, we used a portfolio analysis method. We constructed portfolios based on message volume and recommendation changes.[4] In Table 4-5 below, we present the results from our analysis.

[4] We also construct portfolios based on message volume and recommendation values. However, we do not find much different results.

Table 4-5: Recommandation Change - Message Volume Matrix

This table reports return results for portfolios sorted by message volume and recommendation changes by tercile calculation method. Panel A reports the average number of stocks in each portfolio. HH-LL represents the difference between portfolios 9 and 1 (i.e. portfolios with high message volume and high recommendation changes and messages with low message volume with low recommendation changes). Cumulative excess returns on these portfolios are then recorded over several holding periods. Bold faced results represent significance at 5% level.

Panel A: Portfolio Numbers					
Reco. Change	No. of Message -->				
↓	Low	Medium	High		
Low	12.66	12.69	1.60		
Medium	6.09	7.82	5.92		
High	5.56	4.72	16.78		
Panel B : 2 days prior to portfolio formation, CAR [-2,-1]					
Reco. Change	No. of Message -->				
↓	Low	Medium	High	High-Low	HH-LL
Low	**-0.67%**	**-0.78%**	-0.31%	0.36%	
Medium	0.06%	-0.14%	0.20%	0.14%	
High	**0.35%**	**0.53%**	**1.11%**	**0.76%**	**1.79%**
High-Low	**1.02%**	**1.30%**	**1.42%**		
Panel C : 0 day since portfolio formation, AR [0]					
Reco. Change	No. of Message -->				
↓	Low	Medium	High	High-Low	HH-LL
Low	**-0.47%**	**-1.14%**	-0.40%	0.07%	
Medium	0.00%	0.00%	0.31%	0.31%	
High	**0.59%**	**0.75%**	**1.25%**	**0.66%**	**1.73%**
High-Low	**1.06%**	**1.88%**	**1.66%**		
Panel D : 2 days following portfolio formation, CAR[+1,+2]					
Reco. Change	No. of Message -->				
↓	Low	Medium	High	High-Low	HH-LL
Low	-0.12%	-0.04%	-0.05%	0.07%	
Medium	-0.15%	-0.20%	-0.27%	-0.12%	
High	0.13%	0.10%	-0.02%	-0.15%	0.10%
High-Low	0.25%	0.14%	0.03%		

From the Panel A of the above table, we find that the portfolio 9 (high message volume with high recommendation changes) has the largest number (16.78) of stocks on average. Portfolio 7 (high message volume with lower recommendation changes) has just 1.60 stocks on average. From Panel B, it can be seen that when recommendation change is high, the difference of cumulative abnormal over two days, (i.e. CAR [-2,-1]), between stocks with high message volume and stocks with low message volume is 0.76% and this result is statistically significant. Panel C of the table shows contemporaneous impact of message boards on stock returns. The difference in abnormal returns between these portfolios on the portfolio formation day is 0.66% and this result is statistically significant. Panel D shows that the differences between these portfolios disappear by as early as one day after the portfolio is formed. These results indicate that when a portfolio is formed based on message board activity, future returns cannot be realised at statistically significant levels. From the differences observed prior to portfolio formation, and putting other results together, we can conclude that message board activity is a response to stock market actions and that they have no predictive power over future returns.

4.5.3 Abnormal Message Board Activity

Our results so far have focused on general relationships between measures of message board activity (message volume and recommendations) and stock returns. This relationship can be different when message board activity is at a level that is abnormally higher than its usual discussion level. We perform event study tests for abnormal message posting days[5] and examine security prices around these days. The results presented in Table 4-6 show the market-adjusted returns for an 11 day period

[5] We also used the number of unique users as a measure to identify event days and performed similar tests but we did not find significant changes to our results.

surrounding the event day. Panel A reports the abnormal returns for each day around the event days and Panel B reports the cumulative abnormal returns over different holding periods surrounding the events. Using the difference between recommendation value on event day and the five-day average prior to the event, we classify events into positive change (i.e. daily consensus recommendation level is greater than the five-day moving average), no change or neutral (daily consensus recommendation level is equal to the five-day moving average) and negative change (daily consensus recommendation level is smaller than the five-day moving average) and results for each event are presented in the same table.

Table 4-6: Excess Return around Abnormal Message Posting Days

This table reports excess return around abnormal levels of messages posting activities on the stock message board. Abnormal level of message posting is defined as a day when (1) time-series message volume is more than the 5-day moving average plus two standard deviations (i.e. 5-d MA + 2 x STD), (2) daily message volume is also in the top decile across 764 firms, and (3) there are at least 10 messages on the event day. Events are further classified into three categories based on daily consensus recommendation level. Returns around positive (daily consensus recommendation level is greater than the 5-day moving average), neutral (daily consensus recommendation level is equal to the 5-day moving average) and negative (daily consensus recommendation level is smaller than 5-day moving average) are also reported. Returns are expressed as percentages. Part A of this table reports the results when event days are identified on message volume criteria. Part B reports the results when event days are identified on number of unique user criteria.

Panel A: Abnormal Return								
Day	All Messages (N=9982)		Positives (N=8141)		Neutral (N=757)		Negatives (N=1084)	
	Mean	t-stat	Mean	t-stat	Mean	t-stat	Mean	t-stat
-5	-0.086	-1.676 *	-0.115	-1.989 **	-0.020	-0.143	0.087	0.551
-4	-0.049	-1.029	-0.061	-1.124	-0.281	-2.007 **	0.197	1.386
-3	-0.016	-0.308	-0.004	-0.065	0.306	1.897 *	-0.330	-2.167 **
-2	0.117	2.193 **	0.080	1.370	0.375	2.799 ***	0.214	1.066
-1	0.507	7.535 ***	0.533	6.941 ***	0.728	3.759 ***	0.156	0.862
0	2.517	21.813 ***	2.777	21.238 ***	3.164	8.554 ***	0.109	0.361
1	-0.083	-1.191	-0.030	-0.388	-0.292	-1.530	-0.332	-1.524
2	-0.038	-0.585	-0.032	-0.423	-0.158	-0.846	-0.004	-0.025
3	0.080	1.371	0.045	0.694	-0.093	-0.524	0.460	2.606 ***
4	0.065	1.080	0.076	1.116	-0.042	-0.271	0.055	0.310
5	0.018	0.309	0.023	0.338	0.009	0.060	-0.009	-0.049
Panel B: Cumulative Abnormal Return								
t-20 to t-1	0.907	3.595 ***	0.822	2.902 ***	2.181	3.046 ***	0.675	0.855
t-10 to t-1	0.497	2.822 ***	0.468	2.385 **	1.401	2.628 ***	0.088	0.155
t-5 to t-1	0.473	3.784 ***	0.434	3.061 ***	1.107	3.266 ***	0.324	0.880
t	2.517	21.813 ***	2.777	21.238 ***	3.164	8.554 ***	0.109	0.361
t+1 to t+5	0.031	0.241	0.065	0.447	-0.575	-1.548	0.203	0.520
t+1 to t+10	-0.420	-2.492 **	-0.454	-2.390 **	-0.739	-1.471	0.061	0.122
t+1 to t+20	-1.337	-5.961 ***	-1.401	-5.515 ***	-1.434	-2.190 **	-0.785	-1.212

*,** and *** are statistically significant at 10%,5% and 1% respectively.

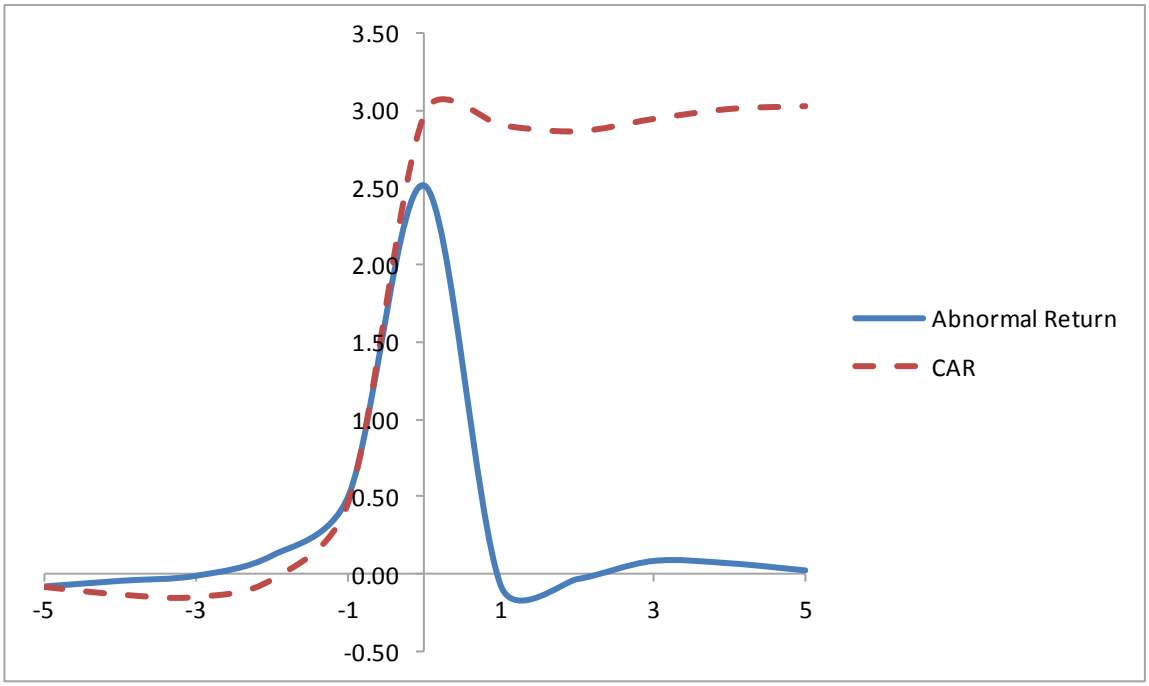
Most of our events (i.e. 8141 events) showed positive recommendation changes. There were fewer events with no changes (757 events) in recommendation value. For all events, as in the second column of Table 4-6, the mean abnormal return is 2.517 per cent, which is statistically significant at the 1% level. We also find significant abnormal and positive returns up to two days prior to the event and the abnormal returns are seen increasing gradually up to the event day. Our results point to the possibility that the abnormal levels of message posting activity we observed are likely to have caused increases in share prices. Immediately after the event day, the returns are negative for the first two days (-0.083% on the first day and -0.038% on the second) but are statistically insignificant.

Panel B of Table 4-6 reports cumulative abnormal returns over different time periods before and after the event days. Cumulative abnormal returns are positive for all time horizons prior to the event (i.e. 0.907% from t-20 to t-1, 0.497% from t-10 to t-1 and 0.473 from t-5 to t-1) and statistically significant. These values are not significant for the first five days after the event and they change to negative over the longer term. For example, cumulative abnormal returns over the first 10 and 20 days after the event are significantly negative (i.e. -0.42% from t+1 to t+10, and -1.34% from t+1 to t+20). This pattern is valid for positive and neutral event types. For the negative events, we note -0.33 per cent and 0.46 per cent significant returns on day *t-3* and day *t+3* only.

Our results suggest that increases in message board activity are likely to be the result of abnormal returns and abnormally high message board discussions are followed by negative returns over the medium term (i.e. 20 days following the events). The results presented on Panel A of Table 4-6 are graphically presented in Figure 4-1, which shows a sudden jump is stock return on the event day. The cumulative returns stay at

around the same level up until day 5. As we discussed in previous paragraphs, these returns change to negative thereafter. Overall, our results strongly suggest that stock returns lead message board activity as evidenced by the pattern of stock returns in the days prior to the abnormally high message board activity.

Figure 4-1: Abnormal Stock Returns around days with high-message-board activity



In order to test how much of the abnormal returns around event days are caused by message boards, we performed a series of regression analyses. Two main models – one with message board variables only and another with firm-specific control variables as well – were employed in this study. Outputs of these regression estimates are presented below in Table 4-7 and Table 4-8. Contemporaneous regression of message board variables with stock returns as in Panel C of Table 4-7 shows that message board variables are positively related to stock returns and have significant F-test results

ranging from 4.62 to 195.38. Thus, message board variables show a significantly positive relationship to the contemporaneous cross-sectional abnormal returns.

Message volume is positively related to abnormal returns from day *'t-2'* to *'t'* and the relationship is statistically significant. Interestingly, abnormal returns one day after the event are negatively related to message volume and the significance of the relationship disappears as early as day *2* after the event. This suggests that much of the abnormal returns can be expected prior to the event and the higher the message volume on event day, the more negative the returns are likely to be the following day. Recommendations and recommendation changes are significantly positive with abnormal returns on day *'t-1'* and *'t'* only. When two message board variables are considered at a time in regressions, as in Model IV and Model V, these relationships remain unchanged. The relationship of message board variables to abnormal returns is not uniform. We observe positive relationships up until event day and the coefficients are negative after the event. High message volume is likely to result in negative returns the following day. However, there appears to be no predictive power of message board variables over returns as early as two days after the event.

Table 4-7: Regression analysis of abnormal Return: Message Board Variables only

This table reports the results of regression analysis on message board variables only. 'Message' is log of 1 plus the number of messages posted on the event day. 'Recommendation' is the consensus daily recommendation level on event day.

Panel A: Dependent Variable = AR (t-2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.000	0.001	0.001	0.001	-0.007 ***
Message	0.036 ***			0.041 ***	0.238 ***
Recommendation		0.138		-0.169	
Recommendation Change			0.043 *		0.023
R-squared	0.002	0.001	0.000	0.002	0.001
Observations	9975	9975	9975	9975	9975
F-Test	15.09 ***	1.00	3.60	8.11 ***	6.96 ***
Panel B: Dependent Variable = AR (t-1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.003 ***	0.002	0.001	0.001	-0.010 ***
Message	0.060 ***			0.045 ***	0.346 ***
Recommendation		0.784 ***		0.448 **	
Recommendation Change			0.163 ***		0.134 ***
R-squared	0.003	0.002	0.003	0.003	0.005
Observations	9979	9979	9979	9979	9979
F-Test	26.86 ***	20.36 ***	32.44 ***	15.94 ***	23.10 ***
Panel C: Dependent Variable = AR (t)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.023 ***	0.016 ***	0.009 ***	0.016 ***	-0.001
Message	0.004 **			0.003	0.310 *
Recommendation		0.202 ***		0.226 ***	
Recommendation Change			0.681 ***		0.654 ***
R-squared	0.000	0.005	0.019	0.005	0.020
Observations	9982	9982	9982	9982	9982
F-Test	4.62 **	46.29 ***	195.38 ***	24.14 ***	99.62 ***
Panel D: Dependent Variable = AR (t+1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.002 *	0.000	-0.001	0.000	0.014 ***
Message	-0.006 ***			-0.072 ***	-0.479 ***
Recommendation		-0.018		0.353	
Recommendation Change			-0.001		0.039
R-squared	0.003	0.000	0.000	0.003	0.002
Observations	9980	9980	9980	9980	9980
F-Test	25.36 ***	1.04	0.00	14.14 ***	12.26 ***
Panel E: Dependent Variable = AR (t+2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.000	-0.001	-0.001	-0.001	0.001
Message	-0.001			-0.019	-0.072
Recommendation		0.006		0.202	
Recommendation Change			0.020		0.026
R-squared	0.000	0.000	0.000	0.000	0.000
Observations	9971	9971	9971	9971	9971
F-Test	1.13	0.14	0.51	1.10	0.57

*,** and *** are statistically significant at 10%,5% and 1% respectively.

Table 4-8 reports the regression estimates for the full model, where we include additional variables to control for firm characteristics and share price momentum. After controlling for company news, size, book-to-market ratio and momentum, message board variables were found to have a significantly positive association with abnormal returns prior to the event. After the event date however, the relationship with message volume changed to negative. These results are consistent with our previous findings. Interestingly, dummy variables for price-sensitive company news are not significant in explaining abnormal returns. We note that size is negatively associated with returns up until event day and the coefficients become positive thereafter.

Table 4-8: Regression analysis of abnormal Return: Full Model

This table reports the results of regression analysis for the full model. 'Message' is log of 1 plus the number of messages posted on the event day. 'Recommendation' is the consensus daily recommendation level on event day. 'User' is log of 1 plus the number of unique users on event day. 'News' is a dummy variable that assumes a value of 1 if there is any price-sensitive company news in 't-2' to 't', with 't' being the event day. 'Size' is the log of market capitalisation of sample firms. 'B-M Ratio' is the ratio of book value to market value of the sample firms. 'Momentum' is the average return on the stock over last 20-days (i.e. from 't-20' to 't-1').

Panel A: Dependent Variable = AR (t-2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	-0.001	0.004 **	0.003 *	-0.002	-0.001
Message	0.119 *			0.209 **	0.115
Recommendation		-0.007		-0.030 *	
Recommendation Change			0.015		0.005
News	0.021	0.026	0.026	0.019	0.022
Size	-0.058 **	-0.058 **	-0.057 **	-0.061 **	-0.058 **
B-M Ratio	0.004	0.005	0.005	0.004	0.004
Momentum	1.355 ***	1.361 ***	1.359 ***	1.355 ***	1.355 ***
R-squared	0.103	0.103	0.103	0.104	0.103
Observations	9744	9744	9744	9744	9744
F-Test	224.77 ***	224.07	224.11	187.84 ***	187.22 ***
Panel B: Dependent Variable = AR (t-1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.006 **	0.015 ***	0.014 ***	0.007 **	0.007 **
Message	0.308 ***			0.270 ***	0.227 ***
Recommendation		0.043 ***		0.013	
Recommendation Change			0.114 ***		0.094 ***
News	-0.124	-0.113	-0.106	-0.123	-0.116
Size	-0.229 ***	-0.225 ***	-0.223 ***	-0.228 ***	-0.225 ***
B-M Ratio	-0.006	-0.004	-0.004	-0.006	-0.005
Momentum	2.002 ***	2.009 ***	2.007 ***	2.002 ***	1.998 ***
R-squared	0.155	0.154	0.155	0.155	0.156
Observations	9745	9745	9745	9745	9745
F-Test	356.65 ***	354.42 ***	357.11 ***	296.69 ***	298.92 ***
Panel C: Dependent Variable = AR (t)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.040 ***	0.056 ***	0.048 ***	0.047 ***	0.041 ***
Message	0.747 ***			0.346 *	0.213
Recommendation		0.171 ***		0.133 ***	
Recommendation Change			0.641 ***		0.623 ***
News	-0.172	-0.149	-0.110	-0.161	-0.119
Size	-0.739 ***	-0.724 ***	-0.711 ***	-0.728 ***	-0.713 ***
B-M Ratio	-0.026 ***	-0.021 ***	-0.018 **	-0.023 ***	-0.019 ***
Momentum	1.088 ***	1.094 ***	1.071 ***	1.085 ***	1.063 ***
R-squared	0.038	0.039	0.053	0.039	0.053
Observations	9745	9745	9745	9745	9745
F-Test	76.56 ***	78.70 ***	108.49 ***	66.17 ***	90.72 ***

Panel D: Dependent Variable = AR (t+1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.009 **	-0.005 **	-0.005 **	0.011 ***	0.009 **
Message	-0.442 ***			-0.585 ***	-0.471 ***
Recommendation		-0.017		0.048 **	
Recommendation Change			-0.006		0.035
News	-0.022	-0.039	-0.039	-0.018	-0.019
Size	0.090 ***	0.087 ***	0.089 ***	0.094 ***	0.092 ***
B-M Ratio	-0.002	-0.004	-0.004	-0.001	-0.001
Momentum	-0.058	-0.075	-0.077	-0.060	-0.060
R-squared	0.004	0.001	0.001	0.004	0.003
Observations	9743	9743	9743	9743	9743
F-Test	7.01	2.10 *	1.93 *	5.98 ***	5.43 ***
Panel E: Dependent Variable = AR (t+2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	-0.001	-0.003	-0.003 *	-0.001	-0.001
Message	-0.045			-0.089	-0.062
Recommendation		0.005		0.015	
Recommendation Change			0.015		0.020
News	0.031	0.029	0.030	0.032	0.033
Size	0.053 *	0.053 *	0.053 *	0.054 *	0.054 *
B-M Ratio	-0.006	-0.006	-0.006	-0.005	-0.005
Momentum	-0.129 **	-0.132 **	-0.132 **	-0.130 **	-0.130 **
R-squared	0.001	0.001	0.001	0.001	0.001
Observations	9734	9734	9734	9734	9734
F-Test	2.27 **	2.12 *	2.16 *	1.88 *	1.88 *

*,** and *** are statistically significant at 10%,5% and 1% respectively.

Book-to-market ratio is negative for days *t-1* and *t* but does not have any explanatory power for post-event abnormal returns. Growth firms are contemporaneously related to positive abnormal returns. Another control variable, momentum in share price, is positively associated with abnormal returns up until event day and the coefficients are negative after the event. This suggests that momentum stocks are likely to be discussed heavily on message boards towards the end of share price runs and the trend is reversed immediately after the high message posting event.

The overall findings from these regression estimates are that message board variables are contemporaneously associated with abnormal stock returns. Similar to Antweiler and Frank (2004), when messages are posted on a given day, there is a

statistically significant negative return on the next day. Smaller stocks, growth stocks and stocks with recent share price momentum are positively related to abnormal returns around the days with abnormally high message board activity. Interestingly, investors are likely to discuss stocks on message boards towards the end of the share price momentum cycle, and prices reverse their course after the event day. Investment recommendations made on message boards do not appear to be useful for economic gain but abnormally high levels of message board discussion can indicate when the share prices are likely to decline from after their current rises.

4.6 Conclusion

In this paper, we have studied the relationship of stock returns and message board activity (message volume and recommendation). By using message board data obtained from *HotCopper*, we examined this relationship under two different conditions – normal message board activity and abnormal message board activity. We used cross-sectional regressions and Granger-causality tests with a lag of two days to study normal relationships. We then employed portfolio analysis methods to take message volume and recommendation level into consideration in our examination. For our study of abnormal message board phenomena, we identified days with abnormally high message board activity and examined stock returns 11 days around the event days. A series of regressions were performed to estimate how much of these abnormal returns could be expected, contemporaneously related and predicted by message board variables.

From our study of time-series relationships, we find that message board variables (i.e. message volume, recommendation level and recommendation changes) are positively related to stock returns and that the causation of these relationships is likely to be two-way. However, the portfolio analysis method showed that double-

sorting portfolios by message volume and recommendation change is not likely to produce much return differential between high recommendation change portfolios and low recommendation change portfolios after the portfolio is formed. Portfolios with high recommendation changes are likely to have significantly higher past returns than portfolios with low recommendation changes.

Our examination of returns around the days with abnormally high message board activity revealed that contemporaneous relationships between message board activity and stock returns are significant and positive. However, abnormally high message posting events are likely to be preceded by abnormal stock returns. Message board variables do not appear to have any predictive power over future returns other than that high level of discussion on message boards lead to negative returns the following day. Investors are likely to discuss stocks on the message board toward the end of share price momentum cycle.

Chapter V: Examination of Volatility around Days with High Message Board Activity

5.1 Introduction

Stock message boards have the potential to influence individual investors' and naive investors' decision making processes. The nature and content of posts can have several ramifications for a firm's share prices and trading characteristics. We found in the previous chapter that message boards follow the stock market. In particular, we found that there was a positive return contemporaneous with the high message board volume but this somewhat reversed in subsequent days. We observed little evidence of new information in the postings on message boards. When this is combined with the finding that abnormal volume of postings tend to follow good stock returns, our results suggest that message board participants follow the market. Abnormally high levels of activity on message boards may have implications for trading variables other than stock returns. In this chapter, we examine the impact of abnormal message posting activity on volatility in share prices. In an efficient market environment, message boards should have no influence on share price volatility.

The study of the impact of message boards on volatility is interesting because changes in share price volatility can have implications for the firm, its management, and other stakeholders. Increased volatility could increase a firm's cost of capital (see Kalay & Loewenstein (1985) and Bhagat, Brickley and Loewenstein (1987) etc.) and reduce a firm's attractiveness for takeover or acquisition (see Ewing (2000), Hof & Saveri (1999) etc.), which could then alter the firm's future investment policy. Increased volatility in share prices may also result in investors' being reluctant to trade in shares. While individual investors may represent a small proportion of share trading volume, their role

in changing a firm's volatility cannot be underestimated. When individual investors act in concert, there is the potential for increases in volatility and message boards may provide a platform for individual investors to act in concert. In an abnormally high message board activity environment, several investors making posts means that several views are being expressed in a short period of time, and the quality and credibility of these views are always in doubt. If the expression of these views creates uncertainty among investors, we could expect to see changes in share price volatility. We present empirical tests, examining volatility changes around days with abnormal message posting activity. Using the *HotCopper* message board data obtained from 2004 to 2008, we find evidence that message board activity increases volatility in the short term. In addition, we find that the number of unique user participations on the online discussion forum is positively related to volatility change.

This paper adds to the literature on message boards and contributes in two main areas. First, rather than focusing on time-series relationships between message board and volatility, we identify days with abnormally high levels of message postings and examine how message board variables are related to stock volatility. In addition, we also examine the association between changes in stock recommendations and stock volatility. Second, we test whether increases in message board participation by unique users systematically results in volatility increases. This paper's primary contribution is to provide empirical evidence on the association between message board activity and stock price volatility. While prior studies such as Antweiler and Frank (2004) have used different approaches to ours by considering intra-day volatility and the time-series relationships of message boards with volatility, there are not many studies examining the volatility consequences of message board activity. We perform an empirical

examination of volatility changes before and after days with abnormal message posting days.

The remainder of the chapter is organised as follows. Section 2 briefly reviews the existing literature and develops the hypotheses we are testing and their implications. Section 3 describes the research data and discusses descriptive statistics of data and variables used in this study. Section 4 discusses the research methods and the volatility measures used in this study. Section 5 discusses empirical results of the tests. Section 6 concludes our findings.

5.2 Development of Hypothesis

The source of volatility, as defined by the fluctuation in stock prices, has long been a debated phenomenon in finance. A theory well-accepted in academic circles is that volatility results from changes in investors' expectations of firms' future cash flows and changes in perceived risk in share prices. Several events can change investors' expectations about the future cash flow for a firm and accordingly, there exists a massive body of literature examining the volatility of stock returns. Some of the factors that are believed to influence firms' volatility which are examined in prior studies include: dividend innovation and volatility (West 1988), volatility increase after stock splits (Ohlson & Penman 1985), contribution by foreign investors to volatility (Choe, Kho & Stulz 1999), the impact of CEO turnover on volatility (Rosenberg, Clayton & Hartzell 2003), and the effect of announcements of dividend increases on volatility (Jayaraman & Shastri 1993). These studies focus on major corporate events to examine structural changes in volatility.

Volatility is also contributed by individual investors when they act in concert and this concerted effort of trading by individual investors has been described as 'noise

trading' in finance literature. In an efficient market environment noise traders should have no effect on volatility. However, this view has been disputed by other studies such as DeLong et al. (1990), who argue that the combined opinions of investors acting together can add a new layer of risk, which then can contribute to an increases in share price volatility. In addition, DeLong et al. (1990) show that the number of unsophisticated investors in the market is positively related to increased volatility. Stock message board have been used as a proxy for unsophisticated investors in previous studies (see Antweiler and Frank (2004), Koski, Rice & Tarhouni (2004) etc.). A study on individual trading by Brown (1999) suggests that unsophisticated investors, when they act together, can increase the volatility of the share market. Another study by Armstrong (2004) has provided detailed evidence of how message boards can be used to gather and disseminate information to favourably alter the trading behaviour of stocks. If stock message boards provide a platform for investors to trade in concert, we are likely to see increases in share price volatility following abnormally high levels of message board discussion.

While there are some suggestions (such as Danthine & Moresi (1993) and Campbell et al. (2001)) that the availability of more information reduces volatility, message board postings can create uncertainty among investors. Message board postings increase the volume of information available to fellow message board participants. While each message board has its own guidelines for posting and also has volunteers to moderate the posts that breach the forum's guidelines, it is still a relatively unregulated information environment. Forums may disseminate messages of all types (good, bad and questionable) and the stock market may become riskier in the short term as investors digest information that has become available to them. With the sudden increase in message board activity, the presence of huge amounts of readily available

information may make it difficult for investors to assess the quality of the information they access. As a result, the riskiness of share prices may increase. If the messages posted create a layer of uncertainty, we could expect to see an increase in share price volatility after the abnormally high message posting days.

Thus, the emergence of the internet applications such as stock message boards not only facilitates the sharing of information among investors but also has the potential to change the riskiness of stock. Stock message boards help investment communities by attracting a new generation of investors (Anders 1999) and by allowing existing investors to communicate more frequently with their fellow members. The continuous flow of information on the internet message board can cause investors to revise their beliefs, update investment signals and amend their future cash flow expectations. With their revision of investment signals, investors can get stimulated to trade more frequently, which then results in increased trading volume. When investors change their views as a result of information they read on message boards, share process may experience fluctuations. To examine the extent to which riskiness increases as a result of message board activity, we relate message board activity to share price volatility in this chapter.

5.3 Research Data

We study over 1.5 million messages posted over a five-year period on 764 large companies (as at 17 July 2009) listed on Australian Stock Exchange. A detailed description of our dataset, including sample firms, data source and summary statistics of firms used in our study, was presented in Chapter 3: Research Design.

5.4 Research Methods

5.4.1 Event Study Methodology

We identify days with abnormally high message posting volume by considering time-series and cross-sectional variations. We presented detailed descriptions of techniques used to classify event days in 'Chapter 3: Research Design'. Volatility changes before and after such events are then compared by using standard statistical tests.

5.4.2 Volatility Measures

One of the arguments we put forward in previous sections was that abnormal message board volume, if it created uncertainty among investors, would likely to result in increased price volatility. We perform empirical tests by using three different proxies for volatility to examine the volatility consequences of message board activity. These volatility measures, as described in subsequent paragraphs, are derived from daily stock returns and have previously been used in other studies such as Ohlson and Penman (1985) as well. The volatility measures are calculated from returns observed over five days around the event day[6].

Probability of Post-Event Squared Return Exceeding Pre-Event Squared Return

One way to test the effects of abnormal message board activity on volatility is to compare the squared daily returns before and after the event (Ohlson and Penman (1985)). We examined the probability of post-event squared returns being greater than pre-event squared returns. Increased message board activity may bring a lot of

[6] To examine the robustness of our findings we also used 10-day observations to calculate volatility but the results and can report that there were little changes in our findings

information (good, bad or neutral) about the stock to forum participants which may be difficult for the participants to analyse. This could result in greater fluctuation in share prices and as a result, the probability of post-event daily squared returns exceeding pre-event daily squared returns should be greater than 0.5. For each event, we compared squared daily returns for various windows around the event and tallied the proportion of cases where post-event squared daily returns exceeded squared daily returns in the pre-event period. For example, squared returns on *'t+1'* were compared with squared returns on *'t-1', 't+2'* results were compared with *'t-2'* results and so on. Thus, for each event, we had five comparisons of squared returns. We then tested the null hypothesis that the probability of post-event volatility exceeding pre-event volatility was equal to 50 per cent, which is mathematically expressed as:

$$H_0: \quad \widehat{\Pr}\left\{\tilde{R}^2_{post} > \tilde{R}^2_{pre}\right\} = 0.5 \ ;$$

$$H_1: \quad \widehat{\Pr}\left\{\tilde{R}^2_{post} > \tilde{R}^2_{pre}\right\} \neq 0.5$$

The binominal z-statistics reported in parentheses is the distributed standard normal conditional upon the null hypothesis that $\widehat{\Pr}\left\{\tilde{R}^2_2 > \tilde{R}^2_1\right\}$=0.5.

Standard deviation of stock returns

The evaluation of message board information may not be limited to daily fluctuations. In fact, this adjustment process may last for a few more days and in order to capture variations of daily returns over periods of a few days, we use standard deviation of stock returns as our another proxy for volatility. By comparing standard deviations before and after the events, we measure the changes in volatility and look at their statistical significance. This measure calculates the standard deviation of returns

over five days around the event days. For each event, σ_{pre} represents the standard deviation of returns over 't-5' to 't-1' and σ_{post} represents the standard deviation calculated for returns from 't+1' to 't+5'. The null hypothesis being tested is that the ratio of standard deviation is equal to 1. Mathematically,

$$H_0: \quad \frac{\sigma_{post}}{\sigma_{pre}} = 1;$$

$$H_1: \quad \frac{\sigma_{post}}{\sigma_{pre}} \neq 1;$$

Expected squared return

In addition to standard deviation, we use expected squared return to examine daily variation of stock returns. The calculations needed for this method can be easily made from our existing data points and have also been used in prior studies (Ohlson & Penman 1985). The results obtained from this method can be compared with those obtained from standard deviation measures. The expectation of squared return is calculated by taking averages of squared returns before and after the events. For each event, $E[R^2_{pre}]$ represents the average of squared daily returns over *'t-5'* to *'t-1'* and $E[R^2_{post}]$ represents averages calculated over *'t+1'* to *'t+5'*. The null hypothesis being tested is that there is no change in expected squared returns before and after the events. Mathematically,

$$H_0: \quad \frac{R^2_{post}}{R^2_{pre}} = 1;$$

$$H_1: \quad \frac{R^2_{post}}{R^2_{pre}} \neq 1;$$

5.5 Empirical Results and Discussion

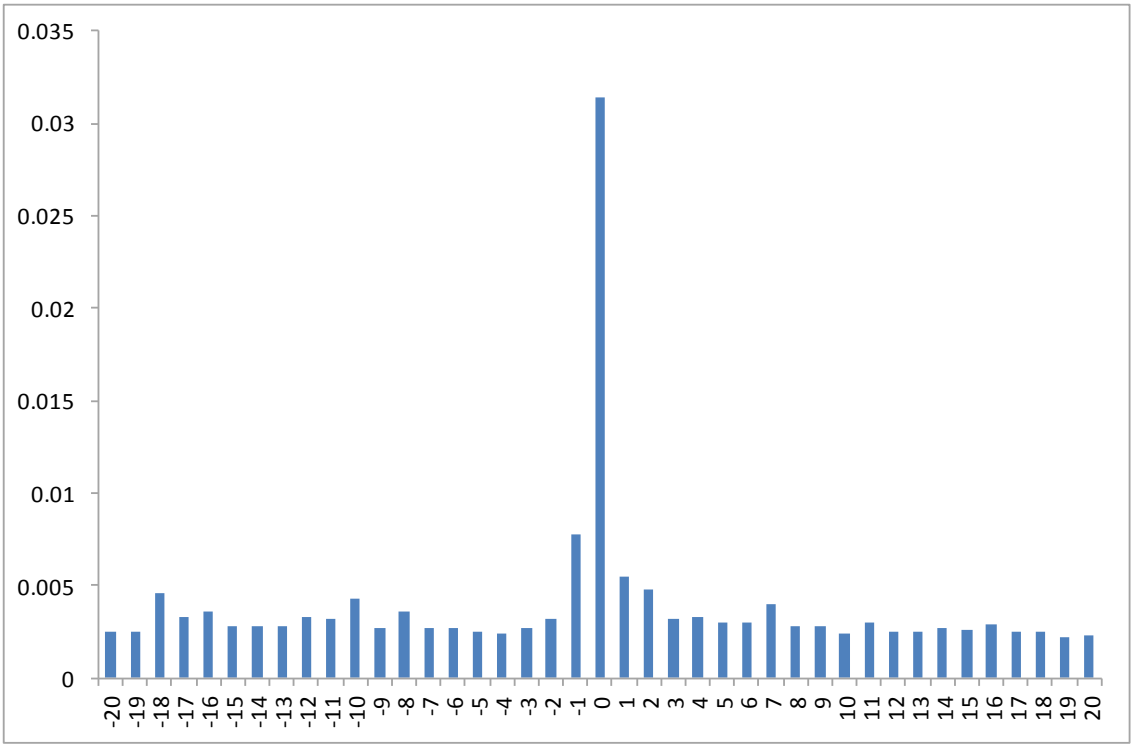
We conducted a simple event study comparison of volatility changes before and after abnormal message board activity. In addition to testing for volatility changes due to high message posting activity, we employed different techniques to seek answers to other questions such as how volatility changes are associated with unique user participation levels (the user effect); how volatility changes are influenced by different recommendation types and how these results vary with the company news and the number of unique users.

5.5.1 Probability of Post-Event Volatility Exceeding Pre-Event Volatility

Figure 5-1 shows the plot of the average values of daily squared returns over 20 days around the event days. Figure 5-1 shows a big increase in squared return on the event day, which is preceded by a slightly higher squared return for the two days prior to the event. After the sudden rise of squared return, there is a gradual adjustment towards the pre-event level and the squared return appears to stay at this level thereafter.

Figure 5-1: Mean squared daily returns around days with high message posting

The event day is denoted as day 0 and t is the trading day relative to the event date



The likelihood of post-event volatility exceeding pre-event volatility was measured in terms of binomial probability[7] and the results are presented in Table 5-1. The probability of post-event squared return being greater than pre-event squared return and is demonstrated by the values which range from 0.5221 (for events with negative recommendation changes) to 0.5377 (for events with positive recommendation changes), and all these values are significantly greater than 0.5. A comparison of standard deviations (from 0.5646 for negative changes to 0.5821 for positive change) and expected squared return (from 0.5517 for negative changes to 0.5720 for positive changes) show the probability of the occurrence of higher volatility after abnormal message posting activity is significantly greater than 0.5.

[7] This probability is calculated as the ratio between events with post-event volatility higher than pre-event volatility and the total number of events.

Table 5-1: Probability of post-event volatility exceeding pre-event volatility

This table reports test results for the null hypothesis that the probability of post-event volatility exceeding pre-event volatility is 0.5. Three different proxies are used to test this null hypothesis. $\widehat{Pr}\{\tilde{R}_2^2 > \tilde{R}_1^2\}$ is the estimated probability that squared daily returns in the post-event period ($\tilde{R}_2^2$) exceed squared daily returns in the pre-event period ($\tilde{R}_1^2$). For each event, we compare squared daily returns for 5 days around the event by tallying the proportion of cases where post-event squared daily returns exceed matched squared daily returns in the pre-event period. The binominal z-statistics reported in parenthesis is distributed standard normal conditional upon the null hypothesis that $\widehat{Pr}\{\tilde{R}_2^2 > \tilde{R}_1^2\}$=0.5.

$\widehat{Pr}\{\sigma_2 > \sigma_1\}$ is the probability that the estimated standard deviation of daily returns for the ith firm in the post-event period exceed those in the pre-event period. For each event, we calculated the standard deviation of return over five days pre- and post-events and compared these standard deviations.

$\widehat{Pr}\{E[R_2^2] > E[R_1^2]\}$ is the probability that the expected squared returns for the event i firm in the post-event period exceed those in the pre-event period. For each event, we calculated average daily squared returns over 5 days pre- and post-events and compared these expected squared returns.

	No. of events	$\widehat{Pr}\{\tilde{R}_{post}^2 > \tilde{R}_{pre}^2\}$	z-stat	$\widehat{Pr}\{\sigma_{post} > \sigma_{pre}\}$	z-stat	$\widehat{Pr}\{R_{post}^2 > R_{pre}^2\}$	z-stat
All	9982	**0.5351**	15.68	**0.5794**	35.50	**0.5703**	31.42
Positive Change	8141	**0.5377**	15.22	**0.5821**	33.13	**0.5727**	29.32
No Change	757	**0.5255**	3.14	**0.5720**	8.86	**0.5720**	8.86
Negative Change	1084	**0.5221**	3.26	**0.5646**	9.51	**0.5517**	7.61

Bold faced probabilities are significant at a 5% level of significance.

5.5.2 Volatility Comparison

We report the volatility comparison before and after the high message posting events in Table 5-2. Under the null hypothesis of the message board activity having no impact on volatility, we would expect these ratios to be equal to 1. However, we find the ratio of post-event standard deviation to pre-event standard deviation to be 1.62 and statistically significant at the 1% level. This indicates that variance of returns after abnormal message board activity is likely to increase significantly. Further examination of standard deviation ratios for different recommendation changes revealed that the ratios were significantly greater than 1 for all recommendation types. Regardless of changes in recommendation, this result indicates that investors find it difficult to evaluate the quality of the huge amounts of information now readily available and as such, increase in message volume is likely to result in increased volatility. Similar to the examination with another measure of volatility, expected squared return, the average ratio is 6.19 and is statistically significant. This suggests an increase in volatility after high message volume events. When scrutinised by recommendation changes, the average ratios were found to vary from 6.22 (for positive changes) to 7.64 (for negative changes) and were all statistically significant. However, the statistical significance of the results for negative recommendation changes is low (i.e. at the 5% level only).

Table 5-2: Standard deviation and expected squared return comparison post- and pre-events

This table reports the comparison of standard deviation and expected squared return post-and pre-events. The null hypothesis is that the ratios of volatility measures will equal 1. For each event, post-event standard deviations were calculated from returns over 5 days after the event and pre-event standard deviations were calculated from returns over 5 days prior to the event. Events were further classified into positive, neutral and negative based on recommendation change.

Events	$\frac{\sigma_{post}}{\sigma_{pre}}$	$\frac{E[R^2_{post}]}{E[R^2_{pre}]}$
All	1.62 ***	6.19 ***
Positive Change	1.62 ***	6.22 ***
No Change	1.61 ***	3.79 ***
Negative Change	1.60 ***	7.64 *

***,** and * are significant results at 1%, 5% and 10% level of significance respectively.

Thus, the evidence in Table 5-1 and Table 5-2 provides reasons to reject the null hypothesis in favour of the hypothesis that message board activity increases volatility over the short term (i.e. over a five-day period). There are two reasons for this. First, the probability of post-event volatilities being greater than pre-event volatilities was higher in all cases. Second, volatility ratios as measured by standard deviation and expected squared returns were greater than 1 at significant statistical levels. When there is a high level of message board activity, different views and sentiments are expressed in a short period of time. It may become difficult for unsophisticated investors to evaluate the quality of all the information available in a short time. The fluctuation of share prices

observed after these events can be considered as a reflection of this confusion and uncertainties.

5.5.3 User Effect

We performed additional tests on the same dataset to examine whether the increase in volatility was proportional to the number of users taking part in message board activity. We counted the number of unique posters on stock forums on the event day. We then examined whether increases in user participation translated into higher volatility. Based on this unique user number, event days were classified into low tercile, medium tercile and high tercile events and some empirical tests were carried out to examine the differences. The results of these statistical tests are presented in Table 5-3.

Table 5-3: User Effect

This table reports the probability of post-event volatility exceeding pre-event volatility at different user levels. 'Unique user' represents the number of unique users posting messages on the event day and this number is classified into one of three terciles – high tertile, medium tertile and low tertile. The table also reports the ratio of two measures of volatility post- and pre-event. ***, ** and * denote results at 1%, 5% and 10% levels of significance respectively.

	No. of events	$\widehat{Pr}\{\tilde{R}^2_{post} > \tilde{R}^2_{pre}\}$		$\frac{\sigma_{post}}{\sigma_{pre}}$		$\frac{E[R^2_{post}]}{E[R^2_{pre}]}$	
Unique User							
Low tercile	2968	0.5241	***	1.5149	***	4.1675	***
Medium tercile	3431	0.5399	***	1.6022	***	4.7064	***
High tercile	3583	0.5396	***	1.7185	***	9.2794	***
High – Low				0.2036	***	5.1118	***

For each event type, the probability of post-event volatility exceeding pre-event volatility was significantly greater than 0.5 (in fact it ranged from 0.5241 to 0.5396). There was a high probability that volatility would increase after abnormal message board activity irrespective of user level participation. Standard deviation ratios ranged from 1.5149 (low user participation) to 1.7185 (high user participation) and were in increasing order. Differences of the ratio in high user participation and low user participation is 0.2036 and is statistically significant at the 1% level, suggesting that the higher the user level, the higher the likelihood of higher post-event volatility. Examination of expected squared returns ratios also points to the same conclusion. The ratios varied from 4.1675 (low user level) to 9.2794 (high user level) and are in increasing order. The difference between high and low user levels is 5.1118 and the test shows that this difference is significant.

The findings from our examination of user effect suggest that the more participants there are on online forums, the greater the increase in volatility. In other words, the extent of the increase in volatility in a particular stock depends on the level of message board discussion on online forums for that security.

5.5.4 Recommendation Effect

Message board postings generally tend to be bullish (Zhang & Swanson 2010) in sentiments and this is evident from our dataset that most of the event days we report in Table 5-4 have positive event days (8588 out of 9882 event days). Investors who have negative or differing views may remain quiet rather than risk criticism from fellow posters. When there is an abnormal level of message volume on stock forums, a lot of positive comments may have been made on these posts. However, we still have a few events where consensus recommendations are at negative or neutral levels. It may be the

case that not all recommendation types have same effect. For example, the level of difficulty in assessing the quality of information may be different when the forum is dominated by positive views to when it is dominated by negative views. Accordingly, one would expect different recommendation levels to have different impacts on volatility. We tested this proposition by categorising the event day recommendation levels in two ways – recommendation tercile and recommendation type. The results of these empirical tests are presented in Table 5-4.

Table 5-4: Recommendation Effect

This table reports the probability of post-event volatility exceeding pre-event volatility under different recommendation levels. Event day recommendation levels are classified into terciles and the results are reported in Panel A. In Panel B, the recommendation levels are classified into positive, neutral and negative categories and the results are reported. The table also reports the ratio of two measures of volatility post- and pre-event. ***, ** and * denote results at 1%, 5% and 10% levels of significance respectively.

	Panel A: Event Day Recommendation Level						
	No. of events	$\widehat{Pr}\{\tilde{R}^2_{post} > \tilde{R}^2_{pre}\}$		$\frac{\sigma_{post}}{\sigma_{pre}}$		$\frac{E[R^2_{post}]}{E[R^2_{pre}]}$	
Low tercile	2942	0.5294	***	1.6201	***	6.0546	***
Medium tercile	3480	0.5375	***	1.5702	***	6.9014	**
High tercile	3560	0.5375	***	1.6629	***	5.5970	***
High-Low				0.0428		-0.4576	
	Panel B: Event Day Recommendation Value						
Positive	8588	0.5370	***	1.6200	***	6.0557	***
Neutral	1147	0.5238	***	1.5560	***	3.3834	***
Negative	247	0.5223		1.8358	***	23.7949	
Negative - Positive				0.2158		17.7392	

Panel A of Table 5-4 shows that volatility increased after abnormal message posting events for all recommendation terciles. Standard deviations vary from 1.6201 (low recommendation tertile) to 1.6629 (high recommendation tercile) but there is no obvious pattern in standard deviation ratios for different event types. The difference

between standard deviations for high and low tercile recommendations is 0.0428 and is not significant. An examination of expected squared return shows that the ratio ranges from 6.0546 (low recommendation tercile) to 5.5970 (high recommendation tercile) and that there is an insignificant difference of -0.4576 between high and low recommendations. Panel B of Table 5-4 shows that volatility increased for all recommendation types following high message posting days. Standard deviation ratios range from 1.6200 for positive recommendations to 1.8358 for negative recommendations and the difference between negative and positive recommendation is minimal (0.2158 without statistical significance). Similarly, the ratios of expected squared returns vary from 6.0557 (positive recommendation) to 23.7947 (negative recommendation) and the difference of ratios, while large (17.7392), is insignificant.

These findings suggest that abnormally high message board activity increases volatility for all recommendation types and levels. While there is some evidence that negative changes in recommendations have a greater impact on volatility, the difference is not statistically significant.

5.5.5 News Effect

So far we found that high volumes of message board activity are followed by increases in volatility. Our findings may have been influenced by many factors, with one of them being company news releases. One potential concern is that high message posting events may be the result of company news and the impact we observed could have resulted from these news releases, not the message board alone. In order to test if our results were affected by this concern, we performed similar tests to those mentioned before by splitting the sample into two subsets – firms with news and firms without news. If there were any 'price-sensitive' company announcements between day *'t-5'*

and day *'t'*, we classified these events as 'with news'. Otherwise, they were classified as 'without news' events. The results of the empirical tests performed on these subsets are reported in Table 5-5.

Table 5-5: Volatility Change with or without Company News

This table reports the probability of post-event volatility exceeding pre-event volatility, and compares volatility for firms with and without news releases from firms. Events with price sensitive news from 't-5' to 't' are classified as 'With News' events. Bold faced results are statistically significant at the 5% level.

	Events	$\widehat{Pr}\{\tilde{R}^2_{post} > \tilde{R}^2_{pre}\}$		$\frac{\sigma_{post}}{\sigma_{pre}}$		$\frac{E[R^2_{post}]}{E[R^2_{pre}]}$	
Panel A: With News							
All	5791	0.5283	***	1.5836	***	4.8976	***
Positive Change	4821	0.5308	***	1.5820	***	4.9583	***
No Change	395	0.5230	**	1.6030	***	3.2522	***
Negative Change	575	0.5117		1.5838	***	5.5227	**
Panel B: Without News							
All	4191	0.5445	***	1.6655	***	7.9709	***
Positive Change	3320	0.5478	***	1.6795	***	8.0480	**
No Change	362	0.5282	**	1.6178	***	4.3698	***
Negative Change	509	0.5340	***	1.6081	***	10.0478	
Panel C: Without News - With News							
All				0.0819	*	3.0733	
Positive Change				0.0975	*	3.0896	
No Change				0.0149		1.1176	
Negative Change				0.0243		4.5251	

Panel A of Table 5-5 shows that for the events with news, the probability of post-event volatility exceeding pre-event volatility is significantly greater than 0.5. Also, the ratios of pre- and post-even day standard deviations (ranges from 1.5820 to 1.6030) and the ratios of pre- and post-event day expected squared returns (ranges from 4.8976 to 5.5227) are significantly greater than 1, suggesting that potential concern about the effect of news releases is valid. However, when we look at the results in Panel B of Table 5-5, the probabilities of post-event event volatilities exceeding pre-event volatilities ranges from 0.5445 to 0.5340 and are statistically significant. Also, the ratios of standard deviations (ranges from 1.6081 to 1.6795) and expected square returns (ranges from 4.3698 to 10.0478) are significantly greater than 1. This indicates that our findings of increased volatility after message-posting events are valid even when there is no news between *'t-5'* and *'t'*. Difference testing of these ratios is reported in Panel C of Table 5-5. The results show that high message posting events without news can bring more volatility changes than events with news. However, the significance of this difference is low at the 10% level and is not observed in other sub-class types.

We find that abnormal message volume tends to increase volatility regardless of company news and while the statistical significance is low, our results indicate that the information in message postings might be causing more disagreement between investors, which is reflected in more volatility in the share price.

5.6 Conclusion

In this chapter, we examined volatility changes brought about by abnormal message board activity. By using message board data from *HotCopper*, we performed event study tests and analysed volatility changes over 10 days around the event days. We employed three different measures of volatility: probability of post-event volatility

being higher than pre-event volatility, standard deviation of stock returns and expected value of squared returns.

We found evidence to suggest that volatility increases after abnormal message board activities. The probability of post-event volatility exceeding pre-event volatility is significantly higher than 50%. Volatility ratios, as measured by standard deviation of stock returns, and expected squared returns suggests that not only probability of occurrence, but also the magnitude of volatility that is increased after the event days. Abnormal levels of postings means a huge volume of information readily available and as a result, rational investors find it difficult to assess the quality of information.

We examined the impact of unique user participation on volatility changes. Event days were classified into different terciles, and volatility changes along with the difference of impacts were studied. Similar to prior findings on noise trading, we found the number of unique user participations was positively related to the volatility change. That is, the extent of the increase in volatility in a particular stock depends on the level of message board discussions on online forums for that security.

We also studied how different recommendation levels and types were related to volatility changes. Event day consensus recommendations were classified into terciles and types (positive, neutral and negative). Our results show that volatility is increased after high message volume for all these sub-classifications and we found no particular evidence to suggest that one recommendation category causes more volatility than others. Our results are also robust to the presence of company news.

Chapter VI: Trading Volume and Liquidity Changes around Days with High Message Posting Activity

6.1 Introduction

The previous two chapters presented empirical results showing how stock message boards could affect stock returns and share price volatility. With the growing level of message board participation, the implication of message board activities may not be limited to returns and volatility only. As message boards also provide platforms for debates on the ideas and news posted on the forum, disagreement among investors expressed on the message boards could also be translate into increased share trades. As such, it is interesting to expand the scope of our study to measure the impact of message boards on share trading volume and the liquidity. An examination of liquidity and trading volume is also necessary because the changes in share prices only measure average reactions to the perceived information in message board postings, whereas trading volume reflects the differences in investors' reactions. In this chapter, we provide further insight into the issue of how message boards contribute to trading volume and liquidity. While most previous studies on message boards focus on potential economic benefits (i.e. stock returns) and risks associated with such trades (i.e. volatility), very few studies have examined the impact of message boards on trading volume and liquidity.

We perform a simple examination of trading volume and liquidity before and after the events of abnormal message posting days. We also present the outputs of regression equations used to examine trading volume and volatility changes around the days with abnormal message board activity. Using message board data obtained from *HotCopper*, we find evidence that message board activity increases trading volume over the short

term. While we find some increase in liquidity immediately after abnormal message board activity, this increase is fully explained by firm-specific characteristics, suggesting that there is no significant impact on liquidity from message boards.

The rest of the chapter is organised as follows. Section 2 reviews the literature relevant to our work. Section 3 describes the data, presents descriptive statistics and discusses the empirical methodology. In Section 4, we present empirical result and offer some discussion. Finally, Section 5 concludes the chapter.

6.2 Literature Review

Trading volume is an important component of the price discovery process. A substantial literature on theoretical models (see Campbell, Grossman & Wang (1993), Blume, D. & O'Hara (1994), He & Wang (1995), Chordia & Swaminathan (2000) and Suominen (2001) etc.) show how trading volume can indicate the information content of returns. In addition to focussing on the information content of stock returns, prior empirical studies have also emphasised the significance of volume in understanding asset price dynamics (see Karpoff (1988), and Gallant, Rossi & Tauchen (1993) etc.). One proposed explanation is that trading volume is the result of disagreement among investors (see Hirshleifer (1977) and Harris and Artur (1993)), each of whom may have access to different information. While the primary purpose of investing / trading is an expectation of economic gain, trading of shares may take place for other reasons too. For example, reasons such as the need for liquidity, or the desire to rebalance a portfolio may also contribute to share trading. Some trades may be based on the revision of information sets as a result of disagreement among investors. If a message board is serving as a platform to express disagreement, we can expect increases in the trading volume of shares after high message posting days. Antweiler and Frank (2004) find that

disagreements between the posted messages are associated with increases in trading volume.

A disagreement among investors may not always result in trade as there are market frictions that can impede trading. Cao, Joshua and Hirshleifer (2002) model the importance of fixed costs to market participation and suggest that potential traders do not always trade. However, they do suggest that conversations among investors are potentially important because a sidelined investor who learns that another investor shares a similar view may decide to invest. This indicates a possibility that message boards may contribute to share trading volume. If communication between existing and new investors is permitted by the stock message boards, we expect message boards to be contributing positively to trading volume. Previous studies on message boards primarily focus on stock returns and volatility consequences. Previous studies such as Sabherwal, Sarkar and Zhang (2008), Zhang and Swanson (2010) examine the impact of message boards on share price return and volatility. However, very little work has been done to understand the message board impact on trading volume.

Another trading variable that message board activity may influence is liquidity in share prices. The importance of liquidity in stock pricing has received growing attention in the academic literature. Amihud and Mendelson (1989) were the first to provide evidence to support the hypothesis that asset liquidity is priced in equilibrium. Subsequently, several studies such as Brennan and Subrahmanyam (1996), and Brennan, Chordia and Subrahmanyam (1998) provide supporting evidence of the impact of liquidity on pricing in equilibrium. In the case of message boards, online discussions could bring stocks to investors' attention and potentially contribute to the generation of coordinated trading activity and hence, they have the potential to impact on liquidity.

The Investor Recognition Hypothesis (IRH), as proposed by Merton (1987), suggests that investors trade more in securities that they are familiar with. Frequent participation in message board discussions – both as a poster and a viewer – may create an impression in investors that they have up-to-date knowledge about a firm's activity. This can make them feel comfortable in making their trading decisions. Irrespective of the quality and reliability of message board posts, these postings may still encourage trading activity among individual investors, which in turn can increase a stock's liquidity. Models of liquidity externality, such as Pagano (1989a), Pagano (1989b) and Dow (2002), argue that coordination among investors may push the stocks to a higher liquidity, Pareto-superior equilibrium. A related work by Admanti and Pfleiderer (1988) shows that the level of concerted trading by investors contributes to liquidity in share prices. If message boards provide an opportunity to generate coordinated trading, we could expect the liquidity of share prices to be improved.

Baker and Stein (2004) take a slightly different approach in explaining the role of unsophisticated investors on market liquidity. By constructing a model incorporating a short sales constraint, their study demonstrates that liquidity is increased by a class of irrational investors who under-react to the private information contained in the order flow. Their argument is that bullish sentiment is associated with an increase in market liquidity. If message board discussions contribute to positive sentiment among investors, then a positive impact on liquidity is expected as a result of message board activity.

As such, apart from return and volatility, understanding the impact of message board activity on trading volume and liquidity is an interesting issue. Not many studies examine volatility and liquidity consequences. The purpose of this study is to examine

how much and to what extent trading volume and liquidity are affected by message board postings.

6.3 Research Data and Methods

We studied over 1.7 million number of messages obtained from *HotCopper*. A detailed description of data sources and summary statistics are presented in Chapter 3: Research Design. As we focus on trading volume and liquidity changes brought about by an abnormal level of message board activity, an event study methodology is considered appropriate to measure these changes. The methods and criteria used to identify high message posting event days have been provided in Chapter 4.

Similar to abnormal returns discussed in Chapter 4, we examine abnormal trading volumes over an 11-day window and the abnormal trading volume is computed as below:

Abnormal trading volume, $\mathbf{AV_{it} = LV_{it} - E[LV_{it}]}$ .....(6.1)

Where, $\mathbf{LV_{it}}$ is natural log transformed trading volume; that is, $\mathbf{LV_{it} = \ln(1 + V_{it})}$, with $\mathbf{V_{it}}$ being the actual trading volume for firm 'i' on day 't'. $\mathbf{E[LV_{it}]}$ represents expected value of actual message volume (or normal volume) and is calculated as an average of trading volume over the previous 60 days starting from 't-6' day. This is computed as below:

$$\mathbf{E[LV_{it}] = \frac{\sum_{t=-6}^{t=-65} \ln(1 + V_{it})}{60}} \quad \text{.....(6.2)}$$

If stock message boards do not bring any changes to trading volume, we construct our null hypothesis as below:

$$\mathbf{H_0: AV_{it} = 0}$$

The null hypothesis is that abnormal trading volume, on average, is zero. We also calculate the cumulative volume over an 11-day window and our expectation under the null hypothesis is that cumulative abnormal volumes will be zero as well.

For liquidity, we use Amihud's (2002) illiquidity measure, which proxies the illiquidity as the ratio of the absolute daily stock return to its dollar trading volume. We select Amihud's (2002) notion of stock liquidity because this measure is based on microstructure models of price impact (Kyle 1985), and is the most highly correlated with intra-day liquidity measures (Hasbrouck 2006). Thus, illiquidity for stock *i* on day *t* is calculated as:

$$Illiq_{it} = \frac{\left|R_{i,t}\right|}{\$Volume_{i,t}}$$

Where $R_{i,t}$ and $\$Volume_{i,t}$ on stock *i* on day *t* are return and dollar trading volume respectively. When a time-series dataset of illiquidity measure is calculated, we compare these illiquidity values against historical estimates. Historical estimates are simply the time-series averages of illiquidity over the previous 60 days up to one day prior to the event window. In an efficient market environment, message posting activity is not expected to bring significant changes in firms' trading variables and as such, we expect the ratio of illiquidity to its historical average to be equal to one. Mathematically,

$$H_0 : \ Illiq_{it} / Illiq_{est} = 1$$

Where $Illiq_{it}$ and $Illiq_{est}$ denote illiquidity measures on days around company news and over-estimation periods respectively. We also calculate the average of illiquidity ratio over an 11-day window. In an efficient market, we expect these ratios to be equal to one for all these periods. After estimating the abnormal trading volume (

AV_{it}) and illiquidity ratios, we perform a series of regression analyses to determine how much of these values are caused by message boards. Message volume, consensus recommendations, and recommendation changes are used as proxies for message board activity and the regressions are run in two different forms – for message board variables only and using a full model to control for other variables.

For regressions with message board variables only,

Model 1:

$$AV_{i,t} = \alpha + \beta_1 Message_{i,t} + \varepsilon_{i,t} \quad \text{.....(6.3)}$$

Model 2:

$$AV_{i,t} = \alpha + \beta_1 Recommendation_{i,t} + \varepsilon_{i,t} \quad \text{.....(6.4)}$$

Model 3:

$$AV_{i,t} = \alpha + \beta_1 RecommendationChange_{i,t} + \varepsilon_{i,t} \quad \text{.....(6.5)}$$

Model 4:

$$AV_{i,t} = \alpha + \beta_1 Message_{i,t} + \beta_2 Recommendation_{i,t} + \varepsilon_{i,t} \quad \text{.....(6.6)}$$

Model 5:

$$AV_{i,t} = \alpha + \beta_1 Message_{i,t} + \beta_2 RecommendationChange_{i,t} + \varepsilon_{i,t} \quad \text{.....(6.7)}$$

where $AV_{i,t}$ represents abnormal trading volume. We repeated similar regressions with the illiquidity ratios as dependent variables and report the results separately. The first three equations are used to study effects of message board proxies separately while the last two equations look at the joint effects of message board proxies (such as message volume, recommendation level and changes in recommendation).

In addition to regressions with message board variables, we control for several firm characteristics that are considered to be important in describing trading activity for a stock. Prior studies (see Wysocki (1999) and Sabherwal, Sarkar & Zhang (2008) etc.)

have also indicated that the relationships between message board and trading variables can be disproportionate, depending upon firm characteristics. To control for these firm characteristics, we re-run the above regressions with additional variables using the equations below:

For regressions with full model,

Model 1:

$$AV_{i,t} = \alpha + \beta_1 Message_{i,t} + \beta_4 News_{i,t} + \beta_5 Size_{i,t} + \beta_6\ BM\ ratio_{i,t} + \beta_7 Momentum_{i,t} + \varepsilon_{i,t}$$
.....(6.8)

Model 2:

$$AV_{i,t} = \alpha + \beta_1 Recommendation_{i,t} + \beta_4 News_{i,t} + \beta_5 Size_{i,t} + \beta_6\ BM\ ratio_{i,t} + \beta_7 Momentum_{i,t} + \varepsilon_{i,t}$$
.....(6.9)

Model 3:

$$AV_{i,t} = \alpha + \beta_1 RecommendationChange_{i,t} + \beta_4 News_{i,t} + \beta_5 Size_{i,t} + \beta_6\ BM\ ratio_{i,t} + \beta_7 Momentum_{i,t} + \varepsilon_{i,t}$$
.....(6.10)

Model 4:

$$AV_{i,t} = \alpha + \beta_1 Message_{i,t} + \beta_2 Recommendation_{i,t} + \beta_3 News_{i,t} + \beta_4 Size_{i,t} + \beta_5\ BM\ ratio_{i,t} + \beta_6 Momentum_{i,t} + \varepsilon_{i,t}$$
.....(6.11)

Model 5:

$$AV_{i,t} = \alpha + \beta_1 Message_{i,t} + \beta_2 RecommendationChange_{i,t} + \beta_3 News_{i,t} + \beta_4 Size_{i,t} + \beta_5\ BM\ ratio_{i,t} + \beta_6 Momentum_{i,t} + \varepsilon_{i,t}$$
.....(6.12)

where,

$AV_{i,t}$ = Abnormal trading volume on *t-2, t-1, t, t+1* and *t+2*, regressed separately

'Message' = log of one plus message volume on event day.

'Recommendation' = the consensus daily recommendation level on event day.

'RecommendationChange' = the difference between consensus recommendation on event day and five-day moving average of recommendations prior to event day

'News' = dummy variable that assumes a value of 1 if there is any price-sensitive company news in *'t-2'* to *'t'*, with *'t'* being the event day.

'Size' = log of market capitalisation of sample firms.

'BM Ratio' = ratio of book value to market value of the sample firms.

'Momentum' = average return on the stock over last 20 days (i.e. from *'t-20'* to *'t-1'*).

Dummy variables representing price-sensitive company announcements have been used in our regression models as one of the control variables. We assign a dummy variable of 1 if there is any price-sensitive news between *'t-2'* and *'t'* but do not categorise whether the news is positive, negative or neutral. News events can bring new information or help adjust investors' prior beliefs, which can then contribute to changes in share prices, trading volume and so on. The other side of the argument is that news events may resolve the disparity in opinion and as a result, message postings might reduce share trading. With the news events as a dummy variable, we examine which way news events contribute to the trading volume and liquidity of share prices. We also control for firm size, book-to-market ratio and momentum in share prices. While smaller and growth firms (i.e. the firms with lower book-to-market ratios) can be favoured by message board participants (Sabherwal, Sarkar & Zhang 2008), the impacts of high message posting activity on these firms are likely to be more obvious. At the same time, the share prices of these smaller and growth firms are likely to be less liquid. As such, we expect firm size and book-to-market ratios to be negatively associated with trading volume and liquidity. However, momentum stocks can attract more share

trading than stocks with no momentum in share prices, and we expect positive associations of the momentum proxy with trading volume.

6.4 Empirical Results

The empirical results from the tests of our hypothesis are presented in the following tables. We discuss the findings on trading volume and liquidity in separate sections as below.

6.4.1 Trading Volume Results

Table 6-1 presents abnormal trading volume around days with high-message posting activity. On the event day, mean abnormal trading volume is 0.767, which is statistically significant at the 1% level. While elevated trading volumes can be seen on all days around the event days, mean values of trading volume and t-statistics are higher for post-event days than that for pre-event days. Average values before the event ranged from 0.068 to 0.161 whereas they ranged from 0.319 to 0.515 on post-event days. When we categorised the events into positive, negative and neutral events based on recommendation changes, trading volume patterns still remain the same; that is, there were increased trading volumes around the event days and average values post-event were greater than pre-event values.

Table 6-1: Abnormal Trading Volume around Abnormal Message Posting Days

This table reports abnormal trading volume around days with abnormal levels of message board activity. An abnormal level of message posting is defined as a day when: (1) time-series message volume is more than the 5-day moving average plus two standard deviations (i.e. 5-d MA + 2 x STD), (2) daily message volume is also in the top decile across 764 firms, and (3) there are at least 10 messages on the event day. Events are further classified into three categories based on daily consensus recommendation level. Abnormal trading volume around positive (daily consensus recommendation level is greater than 5-day moving average), neutral (daily consensus recommendation level is equal to the 5-day moving average) and negative (daily consensus recommendation level is smaller than 5-day moving average) are also reported. Part A (Part B) of this table reports the results when event days are identified on message volume (number of unique user) criteria.

Panel A: Abnormal Trading Volume								
Day	All Messages (N=8566)		Positives (N=7154)		Neutral (N=658)		Negatives (N=754)	
	Mean	t-stat	Mean	t-stat	Mean	t-stat	Mean	t-stat
-5	0.082	6.198 ***	0.062	4.340 ***	0.173	3.129 ***	0.174	4.164 ***
-4	0.068	5.008 ***	0.048	3.281 ***	0.167	3.083 ***	0.155	3.414 ***
-3	0.086	6.243 ***	0.072	4.792 ***	0.187	3.452 ***	0.130	2.871 ***
-2	0.089	5.813 ***	0.075	4.494 ***	0.266	4.508 ***	0.080	1.621
-1	0.161	9.284 ***	0.133	6.958 ***	0.427	6.610 ***	0.203	3.823 ***
0	0.767	39.785 ***	0.744	34.756 ***	1.134	15.215 ***	0.703	13.102 ***
1	0.515	28.040 ***	0.485	23.674 ***	0.846	12.397 ***	0.527	10.470 ***
2	0.399	23.700 ***	0.379	20.319 ***	0.677	10.952 ***	0.370	7.429 ***
3	0.343	21.421 ***	0.330	18.764 ***	0.587	9.888 ***	0.282	5.590 ***
4	0.319	20.227 ***	0.304	17.700 ***	0.621	10.748 ***	0.234	4.450 ***
5	0.287	18.427 ***	0.283	16.609 ***	0.534	9.319 ***	0.150	3.016 ***
Panel B: Cumulative Abnormal Trading Volume								
t-20 to t-1	2.549	13.465 ***	2.317	11.183 ***	4.085	6.059 ***	3.240	5.162 ***
t-10 to t-1	1.230	11.678 ***	1.061	9.203 ***	2.272	5.941 ***	1.779	5.152 ***
t-5 to t-1	0.511	8.795 ***	0.420	6.591 ***	1.151	5.464 ***	0.751	3.972 ***
t	0.767	39.785 ***	0.744	34.756 ***	1.134	15.215 ***	0.703	13.102 ***
t+1 to t+5	1.768	27.265 ***	1.705	23.802 ***	2.866	12.537 ***	1.472	7.280 ***
t+1 to t+10	2.840	24.613 ***	2.764	21.792 ***	4.550	11.156 ***	2.199	5.909 ***
t+1 to t+20	2.328	20.254 ***	2.047	17.882 ***	0.659	9.386 ***	0.350	4.358 ***

*,** and *** are statistically significant at 10%,5% and 1% respectively.

Cumulative abnormal trading volumes are reported in Panel B of Table 6-1. Mean values are significantly greater than zero for all different time horizons. There appear to be increases in trading volume for the first few weeks after the high-message posting activity. For five days and ten days prior to the events, the values are 0.511 and 1.23 respectively. The values for five days and ten days following the events are 1.768 and 2.840 respectively. We observe a similar pattern for all (positive, negative and neutral) event types. These results from Table 6-1 suggest that regardless of event types, trading volume appears to increase following high message board activity. While trading volume is significantly greater than zero for all days in the 11-day event window, increased volume after the event is easily noticeable.

Several studies including Harrison and Kreps (1978), Buraschi and Jilstov (2003), David (2003), Hong and Stein (2003), Qu, Starks and Yan (2003), and Scheinkman and Xiong (2003) and others suggest that differences of opinion among market participants generate trading volume. From our results of increased trading volume after high message posting days, it is likely that high message posting activities are the result of differences of opinion among investors. However, Zhang and Swanson (2010) offer a different perspective on message boards. They find that most of the message board posts are bullish in nature. If an investor has a different view from the crowd, the investor is likely refrain from posting a message in order to avoid criticism by other investors who are bullish about the firm. This causes bullish posts to prevail on message boards. While high message posting event days are generally dominated by bullish sentiments, differences of opinion may still exist in these postings and hence, an increase in trading volume over shorter-term. We found that increased trading volume after high message posting activity occurred for all three event types (positive, negative and neutral).

Regression estimates of message board variables with trading volume are reported in Table 6-2. The dependent variable used in these regression models is abnormal trading volume. Message board variables and firm characteristics are used as independent variables. In most of the regression equations, message volume is positively related to trading volume and the relationship is significant. These results suggest that high message posting can be expected on event days based on elevated level of trading volume prior to the events. This increased message volume on event day is then further related to increases in trading volume after the events.

Similarly, the recommendation levels on event days are seen to be significant but negatively related to abnormal trading volume. These results suggest that high message posting activity with negative recommendation levels is more likely to result in large trading volume than high message posting activity with positive recommendation levels. As Pleis (2007) suggests, negative comments made on the internet are more influential on individual investors' investment decisions than positive comments. Consistent with Pleis (2007), we can draw an inference from our findings that investors are likely to pay much more attention to negative discussions than positive or neutral content and hence, there is a negative relationship between trading volume and recommendation level. A similar regression with recommendation changes shows different relationships to trading volume at different stages of the event window. There is a negative and significant relationship prior to the events (i.e. days 't-2' and 't-1') but the relationship is significant and positive on and after the event days. This suggests that high-message posting events with increases in recommendation level relative to the five-day average are likely to generate large trading volumes. With an increase in the recommendation level on message boards, it is likely that more new trades will be generated.

Table 6-2: Regression analysis of Abnormal Trading Volume: Message Board Variables only

This table reports the results of regression analysis on message board variables only. Abnormal trading volume is used as the dependent variable. 'Message' is log of 1 plus the number of messages posted on the event day. 'Recommendation' is the consensus daily recommendation level on event day.

Panel A: Dependent Variable = AV(t-2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.019	0.132 ***	0.142 ***	-0.076	0.011
Message	0.021			0.074 ***	0.042 **
Recommendation		-0.945 **		-0.177 ***	
Recommendation Change			-0.216 ***		-0.252 ***
R-squared	0.001	0.001	0.001	0.001	0.002
Observations	9653	9653	9653	9653	9653
F-Test	1.06	5.68 **	10.99 ***	7.16 ***	7.46 ***
Panel B: Dependent Variable = AV(t-1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.274 ***	0.263 ***	0.237 ***	0.125	0.264 ***
Message	-0.034			0.049 *	-0.009
Recommendation		-0.223 ***		-0.277 ***	
Recommendation Change			-0.307 ***		-0.300 ***
R-squared	0.000	0.003	0.002	0.003	0.002
Observations	9653	9653	9653	9653	9653
F-Test	2.12	24.70 ***	17.33 ***	13.83 ***	8.73 ***
Panel C: Dependent Variable = AV(t)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.178 **	0.797 ***	0.709 ***	-0.032	0.181 **
Message	0.177 ***			0.293 ***	0.169 ***
Recommendation		-0.655		-0.392 ***	
Recommendation Change			0.235 ***		0.092
R-squared	0.005	0.000	0.001	0.009	0.005
Observations	9653	9653	9653	9653	9653
F-Test	47.26 ***	1.73	8.19	44.63	24.21
Panel D: Dependent Variable = AV(t+1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.028	0.541 ***	0.461 ***	-0.148 *	0.032
Message	0.146 ***			0.244 ***	0.137 ***
Recommendation		-0.573		-0.329 ***	
Recommendation Change			0.222 ***		0.105
R-squared	0.004	0.000	0.001	0.007	0.004
Observations	9651	9651	9651	9651	9651
F-Test	35.53 ***	1.46	8.04 ***	33.98 ***	18.62 ***
Panel E: Dependent Variable = AV(t+2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.034	0.406 ***	0.341 ***	-0.077	0.039
Message	0.109 ***			0.171 ***	0.097 ***
Recommendation		-0.162		-0.207 ***	
Recommendation Change			0.233 ***		0.151 **
R-squared	0.002	0.000	0.001	0.004	0.003
Observations	9642	9642	9642	9642	9642
F-Test	23.78	0.14	10.64	19.50	13.98 ***

*,** and *** are statistically significant at 10%,5% and 1% respectively.

We ran the regressions with firm characteristics and other control variables to see how much of these relationships are explained by these variables. News dummies do not appear to have any association with trading volume prior to the event but the relationship is significantly positive after the event days. The significance of the results, however, decreases after the event. Trading volume suggests no prior expectation of price-sensitive company news but when it does arrive, investors adjust their beliefs and accordingly, trading volume can increase. As per our expectations, we find a negative association of trading volume with market size and book-to-market ratio. Since message board participants are reported to favour small firms and growth firms (Sabherwal, Sarkar & Zhang 2008), the level of discussion should be higher for these firms than for other firms. Our results suggest that increased trading volume is also obvious in these firms. The relationship between book-to-market ratio and trading volume is, however, very short-lived (i.e. significant from *'t-1'* to *'t+1'* only). Proxies for momentum variables have positive and significant coefficients for all days around the event days. The higher the momentum in share prices, the larger the trading volume is likely to be for highly discussed stocks.

Table 6-3: Regression analysis of Abnormal Trading Volume: Full Model

This table reports the results of regression analysis for the full model. Abnormal trading volume is used as the dependent variable. 'Message' is log of 1 plus the number of messages posted on the event day. 'Recommendation' is the consensus daily recommendation level on event day. ' 'News' is a dummy variable that assumes a value of 1 if there is any price-sensitive company news in 't-2' to 't', with 't' being the event day. 'Size' is the log of market capitalisation of sample firms. 'B-M Ratio' is the ratio of book value to market value of the sample firms. 'Momentum' is the average return on the stock over last 20-days (i.e. from 't-20' to 't-1').

Panel A: Dependent Variable = AV (t-2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.185 **	0.295 ***	0.310 ***	0.083	0.181 **
Message	0.016			0.077 ***	0.042 **
Recommendation		-0.012 ***		-0.020 ***	
Recommendation Change			-0.027 ***		-0.031 ***
News	0.067	0.068	0.066	0.065	0.065
Size	-0.033 ***	-0.034 ***	-0.034 ***	-0.035 ***	-0.035 ***
B-M Ratio	-0.010	-0.010	-0.019	-0.052	-0.041
Momentum	0.235 ***	0.237 ***	0.238 ***	0.236 ***	0.236 ***
R-squared	0.044	0.045	0.046	0.046	0.046
Observations	9468	9468	9468	9468	9468
F-Test	86.84 ***	88.66 ***	90.56 ***	75.62 ***	76.18 ***
Panel B: Dependent Variable = AV (t-1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.542 ***	0.539 ***	0.509 ***	0.377 ***	0.537 ***
Message	-0.041 *			0.059 **	-0.009
Recommendation		-0.027 ***		-0.033 ***	
Recommendation Change			-0.038 ***		-0.037 ***
News	0.080	0.079	0.076	0.077	0.077
Size	-0.050 ***	-0.052 ***	-0.051 ***	-0.053 ***	-0.051 ***
B-M Ratio	-0.224 **	-0.262 **	-0.267 **	-0.294 ***	-0.263 **
Momentum	0.250 ***	0.253 ***	0.252 ***	0.251 ***	0.252 ***
R-squared	0.042	0.045	0.044	0.046	0.044
Observations	9468	9468	9468	9468	9468
F-Test	82.71 ***	89.85 ***	87.96 ***	75.67 ***	73.32 ***
Panel C: Dependent Variable = AV (t)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	1.011 ***	1.632 ***	1.528 ***	0.765 ***	1.011 ***
Message	0.167 ***			0.316 ***	0.169 ***
Recommendation		-0.014 ***		-0.049 ***	
Recommendation Change			0.013		-0.002
News	0.135 **	0.141 **	0.142 **	0.130 **	0.134 **
Size	-0.153 ***	-0.154 ***	-0.152 ***	-0.157 ***	-0.153 ***
B-M Ratio	-0.510 ***	-0.442 ***	-0.425 ***	-0.613 ***	-0.512 ***
Momentum	0.249 ***	0.259 ***	0.255 ***	0.251 ***	0.249 ***
R-squared	0.068	0.065	0.064	0.075	0.068
Observations	9468	9468	9468	9468	9468
F-Test	138.86 ***	130.91 ***	129.68 ***	128.47 ***	115.71 ***

Panel D: Dependent Variable = AV (t+1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.547 ***	1.047 ***	0.953 ***	0.353 ***	0.548 ***
Message	0.135 ***			0.254 ***	0.132 ***
Recommendation		-0.011 **		-0.039 ***	
Recommendation Change			0.015 **		0.004
News	0.101 *	0.106 *	0.107 *	0.097	0.101 *
Size	-0.095 ***	-0.095 ***	-0.094 ***	-0.098 ***	-0.094 ***
B-M Ratio	-0.343 ***	-0.288 **	-0.271 **	-0.425 ***	-0.339 ***
Momentum	0.241 ***	0.248 ***	0.245 ***	0.242 ***	0.240 ***
R-squared	0.049	0.046	0.046	0.054	0.049
Observations	9466	9466	9466	9466	9466
F-Test	97.70 ***	92.11 ***	91.78 ***	89.89 ***	81.44 ***
Panel E: Dependent Variable = AV (t+2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.480 ***	0.816 ***	0.741 ***	0.354 ***	0.481 ***
Message	0.092 ***			0.169 ***	0.085 ***
Recommendation		-0.006		-0.025 ***	
Recommendation Change			0.016 **		0.008
News	0.075	0.078	0.079	0.073	0.076
Size	-0.077 ***	-0.077 ***	-0.076 ***	-0.079 ***	-0.077 ***
B-M Ratio	-0.166	-0.129	-0.114	-0.219 **	-0.158
Momentum	0.224 ***	0.229 ***	0.226 ***	0.225 ***	0.223 ***
R-squared	0.045	0.043	0.043	0.047	0.045
Observations	9457	9457	9457	9457	9457
F-Test	88.22 ***	85.04 ***	85.59 ***	77.71 ***	73.74 ***

*,** and *** are statistically significant at 10%,5% and 1% respectively.

We also examine trading volume from another perspective. For each day we formed a portfolio based on message volumes and recommendation changes and examined the trading volume over different time horizons. We performed a similar examination by double-sorting the portfolios by recommendation value and message volume as well but did not note much difference in our findings and hence, report the results for recommendation change only. The results of this portfolio analysis are presented in Table 6-4 below. Panel A shows the average number of stocks included in nine different portfolio types. On average, portfolios with high message volume and high recommendation changes included 13.75 stocks a day whereas portfolios with low message volume and low recommendation changes contained 11.306 stocks a day.

Panel B of the table reports cumulative abnormal trading volume over two days prior to portfolio formation day. Cumulative abnormal trading volume on the event day and two days following the event are reported in Panel C and Panel D respectively. The difference between high and low recommendation change portfolios is significantly negative prior to portfolio formation but is significantly positive on the event day. The differences, albeit positive, are not significant following the event. Our results suggests that stocks are traded less before high recommendation upgrades and more trading volume is involved on the recommendation change day and the subsequent two days.

Table 6-4: Recommendation-Message Matrix

This table reports abnormal trading volume for portfolios sorted by message volume and recommendation level (changes) classified by tertile calculation. Cumulative excess returns on these portfolios are then recorded over several holding periods. Bold faced results represent significance at the 5% level.

Panel A: Portfolio Numbers					
Reco. Change	No. of Message -->				
⇩	Low	Medium	High		
Low	11.306	7.766	7.240		
Medium	10.733	8.425	6.067		
High	3.410	7.144	13.750		
Panel B : 2 days prior to portfolio formation, CAV [-2,-1]					
Reco. Change	No. of Message -->				
⇩	Low	Medium	High	High-Low	HH-LL
Low	**0.557**	**0.609**	**0.864**	**0.307**	
Medium	**0.424**	**0.474**	**0.595**	**0.171**	
High	**0.353**	**0.428**	**0.565**	**0.213**	0.008
High-Low	**-0.204**	**-0.181**	**-0.299**		
Panel C : 0 day since portfolio formation, AV [0]					
Reco. Change	No. of Message -->				
⇩	Low	Medium	High	High-Low	HH-LL
Low	**0.206**	**0.254**	**0.397**	**0.191**	
Medium	**0.260**	**0.352**	**0.426**	**0.165**	
High	**0.288**	**0.388**	**0.618**	**0.330**	**0.412**
High-Low	**0.081**	**0.135**	**0.221**		
Panel D : 1 day following portfolio formation, CAV[+1,+2]					
Reco. Change	No. of Message -->				
⇩	Low	Medium	High	High-Low	HH-LL
Low	**0.364**	**0.430**	**0.661**	**0.297**	
Medium	**0.374**	**0.482**	**0.609**	**0.235**	
High	**0.409**	**0.490**	**0.801**	**0.392**	**0.438**
High-Low	0.045	0.061	**0.140**		

6.4.2 Liquidity Results

Table 6-5 presents mean illiquidity ratios for days around high-message posting event days. An illiquidity ratio is the ratio of the daily Amihud's (2002) illiquidity measure to its historical average over 60 days. The historical average is calculated over the 60 day period that ends one day prior to the event day (i.e. from *t-65* to *t-6*). Illiquidity ratios are greater than one for all days within the event window, suggesting that the stocks are less liquid around days with high-message events. On the event day, the mean illiquidity ratio is 1.165 and is statistically significant at the 1% level. Mean values of illiquidity ratios and t-statistics are similar for pre- and post-event days. When the events are categorised into positive, negative and neutral event days, we note that the illiquidity effect is more obvious on positive and negative event days than on neutral event days. For neutral events, the illiquidity ratio is 0.84 and is significant at the 1% level on event days. While insignificant, the ratio is less than one for days following the events, suggesting that liquidity is increased by high-message posting activity.

Table 6-5: Abnormal Illiquidity around Days with Abnormal Message Posting Activity

This table reports illiquidity ratios around days with abnormal levels of message board activity. An event day is defined as the day when (1) time-series message volume is more than the 5-day moving average plus two standard deviations (i.e. 5-d MA + 2 x STD), (2) daily message volume is also in the top decile across the 764 firms in the sample, and (3) there are at least 10 messages on the event day. Events are further classified into three categories based on daily consensus recommendation level. Illiquidity ratios around positive (daily consensus recommendation level is greater than 5-day moving average), neutral (daily consensus recommendation level is equal to the 5-day moving average) and negative (daily consensus recommendation level is smaller than 5-day moving average) recommendations are also reported. Illiquidity is calculated by using Amihud's (2002) method and reported values are the ratio between illiquidity on the day to its historical average over previous 60 days. Returns are expressed as a percentage. Part A (Part B) of this table reports the results when event days are identified on message volume (number of unique user) criteria.

Panel A: Illiquidity Ratio								
Day	All Messages (N=9982)		Positives (N=8141)		Neutral (N=757)		Negatives (N=1084)	
	Mean	t-stat	Mean	t-stat	Mean	t-stat	Mean	t-stat
-5	1.372	7.317 ***	1.367	7.974 ***	1.473	1.037	1.347	2.901 ***
-4	1.329	7.579 ***	1.329	7.012 ***	1.141	1.153	1.455	2.703 ***
-3	1.257	8.682 ***	1.272	8.179 ***	0.953	-0.789	1.330	3.479 ***
-2	1.312	5.177 ***	1.328	4.599 ***	1.175	1.127	1.275	3.850 ***
-1	1.285	8.288 ***	1.326	8.020 ***	0.942	-0.928	1.192	3.163 ***
0	1.165	6.447 ***	1.175	5.976 ***	0.840	-3.024 ***	1.298	4.146 ***
1	1.132	3.368 ***	1.146	3.219 ***	0.738	-5.721 ***	1.279	2.640 ***
2	1.111	4.046 ***	1.121	4.012 ***	0.922	-0.647	1.158	2.092 **
3	1.282	4.685 ***	1.304	4.233 ***	0.900	-1.339	1.359	4.016 ***
4	1.275	5.344 ***	1.264	6.268 ***	0.883	-1.175	1.619	1.759 *
5	1.277	7.622 ***	1.299	7.326 ***	0.839	-2.782 ***	1.387	3.202 ***
Panel B: Mean Illiquidity Ratio								
t-20 to t-1	1.391	16.716 ***	1.390	16.140 ***	1.283	2.560 **	1.471	5.212 ***
t-10 to t-1	1.380	14.039 ***	1.396	13.082 ***	1.151	1.655 *	1.407	5.143 ***
t-5 to t-1	1.351	12.587 ***	1.367	11.724 ***	1.159	1.304	1.356	5.776 ***
t	1.165	6.447 ***	1.175	5.976 ***	0.840	-3.024 ***	1.298	4.146 ***
t+1 to t+5	1.192	8.086 ***	1.198	7.969 ***	0.88	-1.79 *	1.349	3.345 ***
t+1 to t+10	1.240	12.363 ***	1.252	11.792 ***	0.97	-0.57	1.330	4.979 ***
t+1 to t+20	0.714	-27.051 ***	0.656	-31.886 ***	0.09	-171.49 ***	0.159	-103.877 ***

*,** and *** are statistically significant at 10%,5% and 1% respectively.

Illiquidity ratios averaged over different time horizons are reported in Panel B of Table 6-5. While the Panel A results suggest a decrease in liquidity around the event days, observation of mean values over the longer term offers different views. Mean average values over the 20 days before and the 20 days after the event are 1.391 and 0.714 respectively. Similarly, over a 10-day period, average values are 1.38 and 1.24 for pre- and post-event days. All these results are significant at the 1% level and suggest that high message posting activity is likely to increase liquidity around periods of abnormal message board activity but this eventually dies out and this pattern is reversed thereafter.

Regression estimates of message board variables with illiquidity ratios on the event days are reported in Table 6-6. The dependent variable used in these regression models is the illiquidity ratio. Message board variables and firm characteristics are used as independent variables. In all the regression equations, message volume and recommendation levels are negatively related to illiquidity ratios but their coefficients are not significant even at the 10% level. Recommendation changes also have negative coefficients on illiquidity ratios but the significance of results appears from event days only. On *t, t+1* and *t+2* days, the coefficients are significantly negative. These results suggest that the higher the recommendation changes, the less illiquid (i.e. more liquid) the stock are likely to be.

Table 6-6: Regression analysis of Illiquidity: Message Board Variables only

This table reports the results of regression analysis on message board variables only. Illiquidity ratios are used as dependent variables. 'Message' is log of 1 plus the number of messages posted on the event day. 'Recommendation' is the consensus daily recommendation level on event day.

Panel A: Dependent Variable = AV(t-2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	1.444 ***	1.357 ***	1.350 ***	1.400 ***	1.442 ***
Message	-0.398			-0.152	-0.294
Recommendation		-0.100		-0.084	
Recommendation Change			-0.154		-0.130
R-squared	0.001	0.001	0.001	0.001	0.001
Observations	9378	9378	9378	9378	9378
F-Test	0.24	0.41	0.36	0.22	0.24
Panel B: Dependent Variable = AV(t-1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	1.347 ***	1.289 ***	1.290 ***	1.355 ***	1.346 ***
Message	-0.187			-0.231	-0.181
Recommendation		-0.010		0.015	
Recommendation Change			-0.022		-0.007
R-squared	0.001	0.001	0.001	0.001	0.001
Observations	9277	9277	9277	9277	9277
F-Test	0.16	0.01	0.02	0.09	0.08
Panel C: Dependent Variable = AV(t)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	1.217 ***	1.191 **	1.240 ***	1.186 ***	1.208 ***
Message	-0.154			0.018	0.104
Recommendation		-0.057		-0.059	
Recommendation Change			-0.307 ***		-0.316 ***
R-squared	0.001	0.001	0.001	0.001	0.001
Observations	9327	9327	9327	9327	9327
F-Test	0.20	0.72	7.88 ***	0.36	3.98 **
Panel D: Dependent Variable = AV(t+1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	1.292 ***	1.131 ***	1.208 ***	1.336 ***	1.283 ***
Message	-0.482			-0.724	-0.240
Recommendation		0.002		0.082	
Recommendation Change			-0.312 *		-0.292 *
R-squared	0.001	0.001	0.001	0.001	0.001
Observations	9320	9320	9320	9320	9320
F-Test	0.84	0.00	3.51 *	0.64	1.85
Panel E: Dependent Variable = AV(t+2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	1.295 ***	1.141 ***	1.188 ***	1.292 ***	1.287 ***
Message	-0.552			-0.534	-0.316
Recommendation		-0.065		-0.006	
Recommendation Change			-0.311 ***		-0.284 **
R-squared	0.001	0.001	0.001	0.001	0.001
Observations	9375	9375	9375	9375	9375
F-Test	2.24	0.83	7.04	1.12	3.86

*,** and *** are statistically significant at 10%,5% and 1% respectively.

Coefficient estimates for our full model regressions are presented in Table 6-7. We run these regressions with firm characteristics and other control variables to see how much of the relationships observed above are explained by firm characteristics. After controlling for these variables, the negative coefficients of recommendation changes we observed in the partial model disappear. While high message posting events bring some increase in liquidity, these increases are found to be fully explained by the control variables. News dummies have negative coefficients for illiquidity ratios, with the coefficient only being significant on the event day. Thus, price-sensitive company news increases the liquidity of stocks on high-message posting event days but the effect does not last any longer. Firm size has positive and significant coefficients with illiquidity ratios on event days but the relationship is negative and significant on other days. Liquidity is likely to increase on smaller firms after the events but on event days, more liquidity is observed on large firms.

The book-to-market ratios do not appear to have significant coefficients on 't-2' but the coefficients are positive and significant on other days. The positive relationship between book-to-market ratio and illiquidity ratio suggests that abnormal message posting activity tends to make value stocks (i.e. stocks with high B-M ratios) less liquid (i.e. the illiquidity ratio is high). As such, increases in liquidity phenomena are observed only on growth (i.e. low book-to-market ratio) stocks. Similarly, we observe negative and significant relationships between momentum variables and illiquidity ratios, which indicate that momentum in share prices can increase the liquidity of momentum stocks.

Table 6-7: Regression analysis of Illiquidity: Full Model

This table reports the results of regression analysis for the full model. Illiquidity ratios are used as dependent variables. 'Message' is log of 1 plus the number of messages posted on the event day. 'Recommendation' is the consensus daily recommendation level on event day. ' 'News' is a dummy variable that assumes a value of 1 if there is any price-sensitive company news in 't-2' to 't', with 't' being the event day. 'Size' is the log of market capitalisation of sample firms. 'B-M Ratio' is the ratio of book value to market value of the sample firms. 'Momentum' is the average return on the stock over last 20-days (i.e. from 't-20' to 't-1').

Panel A: Dependent Variable = AV (t-2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	1.639 ***	1.658 ***	1.657 ***	1.625 ***	1.639 ***
Message	0.034			0.119	0.058
Recommendation		-0.015		-0.028	
Recommendation Change			-0.024		-0.029
News	-0.989	-0.987	-0.990	-0.992	-0.992
Size	-0.588 *	-0.589 **	-0.589 **	-0.591 **	-0.589 **
B-M Ratio	0.005	0.005	0.005	0.005	0.005
Momentum	-5.044 ***	-5.039 ***	-5.040 ***	-5.043 ***	-5.042 ***
R-squared	0.012	0.012	0.012	0.012	0.012
Observations	9218	9218	9218	9218	9218
F-Test	22.98 ***	22.98 ***	22.98 ***	19.15 ***	19.15 ***
Panel B: Dependent Variable = AV (t-1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	1.404 ***	1.380 ***	1.386 ***	1.463 ***	1.405 ***
Message	0.064			-0.302	-0.061
Recommendation		0.089		0.122	
Recommendation Change			0.145		0.150
News	-0.098	-0.096	-0.084	-0.085	-0.081
Size	-0.344 **	-0.335 **	-0.337 **	-0.331 **	-0.337 **
B-M Ratio	0.014 ***	0.014 ***	0.014 ***	0.014 ***	0.014 ***
Momentum	-5.374 ***	-5.385 ***	-5.382 ***	-5.376 ***	-5.380 ***
R-squared	0.062	0.062	0.062	0.062	0.062
Observations	9121	9121	9121	9121	9121
F-Test	119.71 ***	119.98 ***	119.97 ***	100.04 ***	99.97 ***
Panel C: Dependent Variable = AV (t)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	0.895 ***	0.879 ***	0.953 ***	0.939 ***	0.894 ***
Message	0.055			-0.217	0.191
Recommendation		0.067		0.091	
Recommendation Change			-0.147		-0.163
News	-1.715 **	-1.716 **	-1.719 **	-1.708 **	-1.728 **
Size	0.427 ***	0.433 ***	0.420 ***	0.436 ***	0.419 ***
B-M Ratio	0.015 ***	0.015 ***	0.015 ***	0.016 ***	0.015 ***
Momentum	-4.651 ***	-4.660 ***	-4.636 ***	-4.654 ***	-4.644 ***
R-squared	0.076	0.076	0.076	0.076	0.076
Observations	9170	9170	9170	9170	9170
F-Test	150.43 ***	150.67 ***	150.86 ***	125.60 ***	125.76 ***

Panel D: Dependent Variable = AV(t+1)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	1.461 ***	1.398 ***	1.494 ***	1.535 ***	1.459 ***
Message	-0.042			-0.501	0.113
Recommendation		0.097		0.153	
Recommendation Change			-0.172		-0.182
News	0.077	0.069	0.066	0.090	0.060
Size	-0.593 ***	-0.584 ***	-0.601 ***	-0.578 ***	-0.602 ***
B-M Ratio	0.009 ***	0.009 ***	0.009 ***	0.009 ***	0.009 ***
Momentum	-5.097 ***	-5.116 ***	-5.084 ***	-5.101 ***	-5.089 ***
R-squared	0.032	0.032	0.032	0.032	0.032
Observations	9161	9161	9161	9161	9161
F-Test	59.64 ***	59.83 ***	59.86 ***	49.95 ***	49.88 ***
Panel E: Dependent Variable = AV(t+2)					
	Model I	Model II	Model III	Model IV	Model V
Intercept	1.307 ***	1.210 ***	1.272 ***	1.345 ***	1.306 ***
Message	-0.257			-0.494	-0.108
Recommendation		0.024		0.079	
Recommendation Change			-0.184		-0.175
News	-0.366	-0.377	-0.388	-0.359	-0.383
Size	-0.230 *	-0.228 *	-0.239 *	-0.222 *	-0.239 *
B-M Ratio	0.011 ***	0.011 ***	0.011 ***	0.011 ***	0.011 ***
Momentum	-4.122 ***	-4.138 ***	-4.119 ***	-4.125 ***	-4.114 ***
R-squared	0.044	0.044	0.044	0.044	0.044
Observations	9214	9214	9214	9214	9214
F-Test	84.92 ***	84.85 ***	85.35 ***	70.91 ***	71.13 ***

*,** and *** are statistically significant at 10%,5% and 1% respectively.

We also investigated the changes in liquidity brought about by high message posting events using portfolio analysis methods. Nine different portfolios were formed by double-sorting message volume and recommendation changes. A similar examination by double-sorting the portfolios by recommendation values and message volume did not produce significantly different results and as such, Table 6-8 reports the results derived from recommendation changes only. The results of this portfolio analysis are presented in Table 6-8 below. Panel A shows the average number of stocks included in nine different portfolio types. On average, portfolios with high message volume and high recommendation changes included 13.20 stocks a day whereas portfolios with low message volume and low recommendation changes contained 10.82 stocks a day. Panel B of the table reports mean illiquidity ratios over the two days prior

to portfolio formation day. Similarly, mean illiquidity ratios on the event day and two days following the event are reported in Panel C and Panel D respectively. The difference of illiquidity between high and low recommendation change portfolios is negative but not significant in almost all time horizons. However, the difference of illiquidity values between high and low message volume portfolio is negative and significant in almost all cases. High message posting stocks tend to have less illiquidity, that is, more liquidity, than less discussed stocks. These results are based on a time-series examination of message board postings and produce slightly different results from the abnormal event days we reported previously. Thus, our results suggest that the higher the number of message board postings, and the greater the positive recommendation level change, the more liquid the share prices are likely to be.

Table 6-8: Recommendation-Message Matrix

This table reports illiquidity ratios for portfolios sorted by message volume and recommendation level (changes) classified by tertile calculation. Mean illiquidity ratios are then calculated over several holding periods. Bold faced results represent significance at the 5% level.

Panel A: Portfolio Numbers					
Reco. Change	No. of Message -->				
↓	Low	Medium	High		
Low	10.821	7.392	6.884		
Medium	10.268	8.096	5.771		
High	3.211	6.882	13.202		
Panel B : 2 days prior to portfolio formation, CAV[-2,-1]					
Reco. Change	No. of Message -->				
↓	Low	Medium	High	High-Low	HH-LL
Low	**1.207**	**1.192**	0.996	**-0.211**	
Medium	**1.373**	**1.222**	**1.151**	**-0.222**	
High	**1.198**	**1.198**	**1.173**	-0.025	-0.035
High-Low	-0.009	0.006	**0.177**		
Panel C : 0 day since portfolio formation, AV[0]					
Reco. Change	No. of Message -->				
↓	Low	Medium	High	High-Low	HH-LL
Low	**1.176**	**1.096**	1.019	**-0.158**	
Medium	**1.221**	**1.185**	**1.134**	-0.088	
High	**1.300**	**1.110**	1.044	**-0.256**	**-0.133**
High-Low	0.118	0.013	0.022		
Panel D : 1 day following portfolio formation, CAV[+1,+2]					
Reco. Change	No. of Message -->				
↓	Low	Medium	High	High-Low	HH-LL
Low	**1.429**	**1.190**	1.048	**-0.381**	
Medium	**1.359**	**1.214**	**1.101**	**-0.258**	
High	**1.352**	**1.173**	1.018	**-0.334**	**-0.411**
High-Low	-0.077	-0.017	-0.031		

6.5 Conclusion

In this chapter, we have examined trading volume and liquidity changes around high-message posting event days. By using message board data from *HotCopper*, we performed event study tests and analysed the changes in these variables before and after

the event days. Days with abnormal levels of message board activity were identified and trading volume and liquidity were examined over 10 days around the event days. We used several regression models to measure the strength of the relationship between message board variables and trading volume and liquidity. In addition to the effects of abnormal message posting events, we examined the general relationship between message boards and trading variables (trading volume and liquidity) by using the method of portfolio analysis.

We find evidence to suggest that trading volume increases after abnormal message board activity (i.e. recommendation level and recommendation changes). Message board volume is positively related to trading volume, whereas daily recommendations made on stock message boards are negatively related to trading volume. Recommendation change is negatively related to trading volume prior to the event but shows positive association with trading volume after abnormal message posting activity. Variables used to control for firm characteristics such as size and book-to-market ratio negative and significant association with trading volume. The momentum variable is positively related to trading volume. These findings suggest that increases in trading volume brought about by abnormal message posting activities are more obvious in small firms, growth firms and firms with share price momentum.

A similar examination of liquidity proxies suggests that message board activity improves the liquidity of stock prices around days with high message board activity but this effect dies out very quickly. The impact on liquidity, however, is fully explained by firm-specific variables and momentum variables. Similar to trading volume effect, we observed liquidity to increase in small and growth firms, and in firms with high momentum in share prices.

Chapter VII: Message Board Recommendations and Future Stock Returns

7.1 Introduction

The previous three chapters presented empirical studies examining the impact of message boards on share trading variables. These chapters focused on the daily effect of message board activity on trading variables such as stock returns, trading volume, volatility and liquidity. The inherent biases in message board recommendations and their impacts on future returns, for example over a month, are also an interesting issue in academic studies. This chapter presents an empirical investigation of the biases in message board recommendations and their impact on future returns after controlling for these biases

Stock message boards can be viewed as playing role in disseminating information and can be considered to be acting as an intermediary in financial markets. Like several other intermediaries such as analysts and the media, message board recommendations have come under scrutiny due to the potential for biases in their recommendations and posts. Message boards are also used for collective analysis of company news when it is released. When company news is released, message board participants attempt to collectively analyse or digest the information contained in the announcements. Thus, one would assume that by facilitating conversation among unsophisticated investors, message boards are playing an important role in contributing to market efficiency. However, recommendations made on message boards may contain biases. For example, existing shareholders tend to share part of the news published somewhere else, whereas investors tend to share the content of broker reports they subscribe to with fellow participants for free and so on. Motivations behind such posts are affected by investors' ownership interests. Similarly, there are other factors such as

overconfidence, disposition and herding that can influence message board recommendations. Not all stocks get equal treatment in message board discussions and it is interesting to identify the biases in message board recommendations. The concept of inherent bias in message board postings is still evolving and the economic usefulness of stock message boards after controlling for these biases is not clear. Our focus in this chapter is on two specific issues of stock message boards: (1) Do investors exhibit any biases in making recommendations? (2) Do message board recommendations add any incremental value to investment decisions?

Using message board data from *HotCopper* and share price data from DataStream, we find that message board participants are likely to favour large firms, growth firms and the firms with momentum in share prices. However, there appears to be no information of value to investors in these posts and our results hold for two different periods –market upturns and downturns.

The remainder of the chapter is organised as follows. Section 2 provides some background to the motivation of this study. We briefly describe our data in Section 3 and Section 4 describes in detail the research methods used in this study. In section 5, we present our findings and offer some discussion to these results. Finally, we offer conclusions in Section 6.

7.2 Literature Review

We first discuss the factors that attract investors to post messages on internet discussion sites and then review the literature to gain an understanding of potential biases in message board participants.

7.2.1 Determinants of Message Postings

Thousands of investors flock to message boards on a daily basis to read, discuss, exchange and share information about stocks. Not all firms get equal attention from message board participants and even the level of attention paid to the most favoured stocks can vary over time. However, the current literature offers mixed, and to some extent contradictory, results. Wysocki (1999) analysed the messages posted on *Yahoo!* message boards over the first six months of 1998 and found that the stocks with high short-selling activity, high market valuations relative to fundamentals, low institutional holding, high trading volume, extreme performance and high analyst followings tend to experience the highest volumes of message board postings. Since not all stocks have short-selling provisions, Wysocki's sample may not be representative of firms with small market capitalisation. A more recent study by Sabherwal, Sarkar and Zhang (2008) offers a different perspective on the determinants of message board postings. They used messages posted on *TheLion.com* for the ten most actively discussed stocks every day. By analysing the messages posted over a period of one year (from July 2005 to July 2006), the authors argue that online posters are most attracted to talk about stocks that are thinly traded and have low institutional ownership.

Two different studies in this field by Wysocki (1999) and Sabherwal, Sarkar and Zhang (2008) have presented slightly differing views. A potential reason for this may be the differences in their study periods. Models developed from the analysis of message board data over six months and one year may not be enough to capture all the variables properly. Another potential reason could be the timing of their analyses. These two analyses were performed seven years apart and the dynamic nature of message boards could have added a few more variables to attract participants to message boards. Even the variables considered to be important in the earlier study may have undergone shifts

in their scale of contribution. Whatever the reason, there is a need to revisit the issue of determinants of message board activity and obtain a better understandingof the factors that impel investors to discuss particular stocks. As such, our study is related to determining the investors' reasons for favouring particular stocks for discussion on stock message boards.

Unlike prior studies on the determinants of message board activity which use message volume as a proxy for the influence of message boards, we use recommendation level and recommendation changes as proxies. This is because, firstly, increases in message volume alone cannot specify the nature of the discussions; that is they cannot show whether the content of the message board postings are positive or negative. Secondly, if one knows consensus recommendations and recommendation changes, one can identify how the investors' collective sentiment is changing over time. By using recommendation level and recommendation changes in our study, we expect to capture the information content of message board posts in a more informative manner than is possible by using message volume alone.

7.2.2 Biases in Message Board Postings

A review of prior works on the determinants of message boards use suggest that there are likely to be some inherent biases in message board recommendations. Message board participants can show preferences in terms of firm size, momentum and growth characteristics of stocks. In this section, we discuss the potential sources of bias that can affect message board recommendations.

Ownership interest:

Participation in message board activity can be assumed to be primarily profit-driven. Investors may be willing to share positive opinions with fellow investors in an

attempt to generate interest in shares they already own. Unlike analysts, investors do not have any career concerns in making recommendations and unlike employees do not have to care for the promotion of the employers' business. Yet, message board recommendations are not bias-free as the sentiment of recommendations on message boards can be affected by posters owning the stock plus a number of other behavioural biases that we discuss in subsequent sections. One major motivation for making recommendations on a message board might be to generate interest in stocks the poster already holds. Prior studies (see DeMarzo, Vayanos & Zwiebel (2003), Antweiler & Frank (2004) etc.) suggest that messages posted about a particular stock are most of the time motivated by investors' ownership of that stock. This points to the possibility that message board recommendations will be dominated by positive views. A study by Zhang and Swanson (2010) on the contents of neutral sentiments expressed on message boards confirms this possibility. They analyse the content of 'Hold' sentiment postings on an internet discussion site and find that even self-disclosed 'Hold' sentiments differ significantly from neutral and are skewed towards bullishness. Thus, it is obvious that the information content of message board recommendations is greatly affected by whether the poster has an ownership interest or not.

Behavioural biases:

Message board recommendations may also be influenced by the behavioural biases of investors. Investors are likely to use message board discussions for investment tips from fellow members and/or to confirm their prior information set with others. Whatever their motivations might be, investors are likely to gain the illusion of knowledge. Park et al. (2010) document that confirmation bias demonstrated by individuals on virtual communities makes them more overconfident of their information, which adversely affects their investment performance. A similar concern is

expressed by Glaser, Webber and Langer (2010). They opine that overconfident investors are more prone to excessive trading which can then lead to poor investment performance. Participation in message boards may make investors overconfident and the recommendations they make may be influenced by their biases rather than any desire for economic gain.

Message board postings may also reflect disposition effects exhibited by individual investors. The tendency to sell assets that have gained value and hold onto assets that have lost value is termed the disposition effect. Following the paper by (Sherfin & Statman 1985), who first coined the term, it has become one of the most studied investor behaviours in the finance literature. Odean (1998) finds that individual investors exhibit disposition effects. Other studies such as Grinblatt and Keloharju (2001), Feng and Seasholes (2005), Frazzini (2006), Dhar and Zhu (2006) and Kumar (2009) provide evidence of such behavioural bias among individual investors. Discussions held on internet sites may also contribute to investors' tendencies to hold on to losing stocks. After the decline of share price or poor performance, share owners who want to hold these stocks may post messages reaffirming their prior beliefs.

Another bias we can expect from message board participants is herding. Similar to analysts' tendencies to herd (i.e. follow the consensus) in making recommendations (Scharfstein & Stein 1990), investors may exhibit herding in their message board recommendations. Another potential cause for herding is that due to a desire to avoid criticism from fellow posters, investors with significantly different opinions from the crowd may prefer to remain silent rather than post negative comments. This may result in message board recommendations becoming full of positive sentiments. A recent study by Sabherwal, Sarkar and Zhang (2008) finds that stock message boards can be

used as a herding device and that message board sentiment can predict trading-related activities.

Thus, message board recommendations may contain the inherent biases of investors. There can be ownership biases and behavioural biases such as disposition, herding and overconfidence. Because of these biases, there may be a tendency to follow particular types of stocks on message board. A similar study on analysts' biases was carried out by Azzi and Bird (2005) and they controlled for these biases to see if there were any economic benefits in following analysts' recommendations. However, few studies have examined the investment value of message board recommendations after controlling for these inherent biases. Our study addresses this issue.

Our study in this chapter makes two important contributions to the current literature. First, we contribute by identifying the biases in recommendations made on a stock message board. Second, our study examines how the recommendations of message board posters perform after controlling for these biases.

7.3 Data and Sample Description

We studied over 1.7 million messages obtained from *HotCopper*. Detailed descriptions of sample firms, data sources and summary statistics of the firms used in our study are presented in Chapter 3 – Research Design.

7.4 Research Methods

In order to study the determinants of message posting activity and the relationship of message board recommendations with future returns, we used a series of regression equations. Levels of message board discussion on a particular firm may vary according its growth characteristics. When the stock gains momentum in share price, it has the potential to attract many message posts on discussion forums. As such, similar

to Azzi & Bird's (2005) study of analysts' recommendations, we analyse variables representing growth/value, momentum and fundamental characteristics (such as size and accrual) of the firm that are considered to have predictive power over future returns. Wherever possible these explanatory variables are calculated at the end of each month. Descriptions of each variable and their calculation are presented below.

7.4.1 Momentum Variables

Momentum in share prices may bring a stock to investors' attention. Message boards can contribute to this process by spreading messages very quickly. When the company is experiencing significant upward momentum in its share price, it is likely to be discussed most on message boards. We use three variables to model momentum in stock performances. Our expectation is that momentum variables are positively related to message boards.

Return for months 't-1' to 't-3' (RETP)

This measure is used as a proxy for momentum and is calculated as the cumulative excess return on the stock from the market return over the previous three months. Mathematically, it is expressed as

$$\sum_{t=-1}^{t=-3} [\ln(1 + monthly\ stock\ return])_t - \ln(1 + market\ return)_t$$

Cumulative adjusted market returns for months 't-4' through to 't-6' (RET2P)

This is another measure of momentum that captures the momentum lagged by three months. We calculate cumulative excess return for three months starting from three months prior to portfolio formation. For each stock, it is calculated as follows:

$$\sum_{t=-4}^{t=-6} [\ln(1 + monthly\ stock\ return])_t - \ln(1 + market\ return)_t$$

Standardised Unexpected Earning (SUE)

In addition to momentum in share price, we use standardised unexpected earning as another measure of momentum. The unexpected earning for each stock at the time at which the consensus recommendation is determined at time *t* is measured by the change in the earning per share (EPS) from the prior period, standardised by the standard deviation of the EPS over the three preceding periods:

$$\frac{(\Delta EPS)_t}{S.D._t}$$

where ΔEPS and *S.D.* represent change in earnings per share and standard deviation of EPS respectively.

7.4.2 Contrarian Variables

We use five different contrarian variables including book-to-market ratio and earning-to-price in our study. We use these measures to examine investors' biases in message board recommendations. The calculation of these ratios is described below:

Book-to-Market Ratio (BMRAT)

The book-to-market ratio for each stock at the time of consensus recommendation is determined as the ratio of book value to market value. Mathematically, the ratio is calculated as:

$$\frac{(Book\ value)_t}{(Market\ Value)_t}$$

Earning-to-Price (ETOP)

The earning-to-price for each stock as at the time of consensus recommendation is defined as the ratio of earning per share to current share price. The ratio is calculated as:

$$\frac{(EPS)_t}{P_t}$$

Sales Growth (SGROWTH)

We use 'sales growth' as a proxy for growth. The sales growth rate for each stock as at the time of consensus recommendation is measured relative to the previous month's sales figure. Mathematiclly, the indicator is determined as :

$$\frac{Sales_t}{Sales_{t-1}} - 1$$

Accrual to Total Assets (ACCRUAL)

Accrual to total assets is another growth indicator and the calcuation of the level of accruals for each stock at the time of consensus recommendation is determined as follows:

$$\frac{\Delta Current\ Assets - \Delta Cash - \Delta Current\ Liabilities - (Depreciation\ and\ Amortization)_t}{\frac{Total\ Asset_t + Total\ Assets_{t-1}}{2}}$$

Size (SIZE)

Size refers to a firm's market capitalisation. In this study, we calculate the 'SIZE' variable as the natural log of a firm's market capitalisation at the end of each month.

7.4.3 Regressions for Determinants of Message Board Activity

In order to capture time series variations in message board variables, we performed panel regressions with fixed effects on our data set. Message board variables were regressed against momentum variables, growth variables, valuation multiples and firm size that were considered to contribute to the levels and changes in levels of message board discussions. We used consensus recommendation level and consensus

recommendation changes as proxies for message board activities. Each recommendation was numerically assigned -2 (strong sell), -1 (sell), 0 (hold), +1 (buy), or +2 (strong buy) and the net recommendation for each stock was calculated every month. Recommendation changes were calculated as the difference between recommendation values for two consecutive months.

We used the following regression model to determine factors contributing to the extent of the preferences of participants in message board activity:

$$Reco_i = \alpha_i + \beta_1 RETP_i + \beta_2 RET2P_i + \beta_3 SUE_i + \beta_4 BMRAT_i + \beta_5 ETOP_i + \beta_6 SGROWTH_i + \beta_7 ACCRUAL_i + \beta_8 SIZE_i + \varepsilon_i \quad \text{.....(7.1)}$$

7.4.4 Future Return Regression

Prior analysis presented in the previous section was aimed at determining what biases message board participants show towards particular stocks. By using regression equations, we attempted to control for these general biases in order to determine how investors' 'unbiased' preferences are correlated with stock performance. Since we are examining consensus recommendation levels and recommendation changes separately, we use the following regression equations :

Model A1:

$$Returns_i = \alpha_i + \beta_1 RECO_i + \varepsilon_i \quad \text{.....(7.2)}$$

Model A2:

$$Returns_i = \alpha_i + \beta_1 RECO_i + \beta_2 QSCORE_i + \varepsilon_i \quad \text{.....(7.3)}$$

Model A3: In this model, we use binary values for each predictive variable considered in our study.

$$Returns_i = \alpha_i + \beta_1 RECO_i + \beta_2 BRETP_i + \beta_3 BRET2P_i + \beta_4 BSUE_i + \beta_5 BBMRAT_i + \beta_6 BETOP_i + \beta_7 BSGROWTH_i + \beta_8 BACCRUAL_i + \beta_9 BSIZE_i + \varepsilon_i \quad \text{.....(7.4)}$$

where the QSCORE measure is calculated as the sum of the eight binary investment signals for a stock used in the above regressions. We re-ran similar regression equations

by replacing 'recommendation level (RECO)' with 'changes in recommendation (RECCHG)'.

7.5 Empirical Results

7.5.1 Preference in Message Board Postings

Table 7-1 reports the regression results on panel data for the determinants of message board activity. We examined consensus recommendation level and change in consensus values as proxies for the preferences of message board participants. We note mixed results for momentum vairables and contrarian variables in contributing to message board activity.

From Panel A, we find that consensus recommendations on message boards have significantly positive associations with the previous three month's returns (RETP) but they have a significantly negative relation to standardised unexpected earning (SUE). However, the significance of negative association with SUE lasts less than that of other momentum variables (i.e. three months' return). This finding suggests that investors are likely to discuss stocks that have experienced increased momentum in share prices recently. For the contrarian variables, we find that consensus recommendation level is negative and significant for book-to-market ratio (BMRAT) and earning-to-price (ETOP) ratios, suggesting that message board participants show a preference for growth firms. We also find significant and positive association of recommendation level with the size of the firm (SIZE) which indicates the possibility of message board participants favouring stocks with large market capitalisation. Our panel regression of data with fixed effects produces an impressive R-squared value of 0.412 which highlights the predictive power of our model in explaining the preferences of message board participants. Also, a significant F-statistic of 3.209 justifies the use of

eight predictive variables in explaining message board recommendations. These findings are to some extent in consistent with prior studies on stock message boards and the coefficients suggest that investors tend to prefer larger growth firms that have expereinced recent positive share price momentum.

Table 7-1: Determinants of Message Board Activity

This table reports regression results for the determinants of message board activity. Regression is performed on panel data with fixed effect. The dependent variables in Panels A and B are consensus recommendation level and consensus recommendation changes respectively. Consensus recommendation is calculated from the messages posted over the last week of each month. RETP is the past 3 months' (i.e. t-1 to t-4) return and RET2P are returns over t-4 to t-6 months. SUE is standardised unexpected earnings. BMRAT is the ratio of the book value to the market value of the firm. ETOP, SGROWTH and ACCRUAL are earning to price, sales growth and accrual to total assets respectively for each stock at the time of consensus recommendation. SIZE is the natural log of market capitalisation of firms at the end of each month.

Panel A: Consensus Recommendation level			
Variable	Coeff.	t-stat	
Intercept	2.503	26.65	***
Momentum variables			
RETP	0.395	2.15	**
RET2P	0.158	0.85	
SUE	-0.110	-1.77	*
Contrarian variables			
BMRAT	-0.049	-2.16	**
ETOP	-1.000	-2.20	**
SGROWTH	-0.015	-0.12	
ACCRUAL	-0.067	-0.35	
SIZE	3.141	2.93	***
Observations		1593	
R-squared		0.412	
F-statistic		3.209878	***
Panel B: Consensus Recommendation Change			
Intercept	0.317	13.56	***
Momentum variables			
RETP	0.128	2.80	***
RET2P	0.010	0.22	
SUE	0.016	1.04	
Contrarian variables			
BMRAT	0.002	0.39	
ETOP	-0.160	-1.42	
SGROWTH	0.025	0.85	
ACCRUAL	-0.036	-0.74	
SIZE	-0.022	-0.08	
Observations		1593	
R-squared		0.183	
F-statistic		1.03	

*,**,*** indicate statistical significance at 10%, 5% and 1% level respectively.

For determinants of recommendation change as reported in Panel B, we find only share price momentum (RETP) relating positively to recommendation changes. This suggests that investors' recommendations are likely to move in the same direction as the share price performance. The model used in Panel B did not produce a significant F-statistic. The R-squared value is also lower than that for Panel A. This indicates that the momentum and contrarian predictive variables used in the study are more relevant in describing consensus recommendation levels than in describing the changes in the level of the recommendations.

7.5.2 Excess Return and Message Board Activity

A simple correlation, the Pearson correlation, is computed between recommendation level and changes to future stock returns and the coefficients are presented in Panel A of Table 7-2. The results show that consensus recommendation level (change) is positively (negatively) correlated with future returns but the significance of the correlation is not strong. In order to examine the correlation of each recommendation type and the recommendation changes, we formed a portfolio for each recommendation type. We report the correlations of these portfolio returns with different recommendation types in Panel B and recommendation change measures in Panel C. All the recommendation types were negatively correlated to future returns. However, we did not observe any significant correlation of these measures with future returns, except for neutral recommendations which indicates a negative correlation with returns. The difference between positive and negative recommendations, although it indicates some excess return, is not that significant. Similarly, each recommendation type and the changes in recommendations do not produce any significant excess returns.

Table 7-2: Consensus Recommendation and Future Returns

Panel A of this table reports the Pearson correlations between message board recommendations and future returns. Panels B and C reports average future returns on portfolios when grouped by recommendation level and recommendation changes respectively. Returns are measured over a month. Consensus recommendation changes are assigned a rating of 1, 0.5 and 0 for Increase, Hold and Decrease respectively. The t-statistics of statistical tests are also reported in Panels B and C.

Explanatory variable	Correlation	
Panel A: Pearson correlation with future return		
Consensus reccomendation level	0.0066	
Consensus Changes	-0.0136	
Portfolio	Mean (Monthly Return)	t-stat
Panel B: Consensus recommendation level: market-adjusted returns		
Positive	-0.004	-0.57
Neutral	-0.045	-1.90 *
Negative	-0.013	-0.93
Positive - Negative	0.009	0.56
Panel C: Consensus recommendation change: market-adjusted returns		
Increase	-0.002	-0.23
Hold	0.008	0.42
Decrease	-0.003	-0.45
INCREASE-DECREASE	0.001	0.24

*,**,*** indicate statistical significance at 10%, 5% and 1% level respectively.

7.5.3 Predictive Ability of Individual and Aggregate Investment Signals

We now evaluate the predictive ability of eight variables as described in the previous section that are used in this study. We present results for the relationships between these variables and future returns in Table 7-3 below. Consistent with previous findings on momentum, we note a strong and positive correlation for all the momentum measures (i.e. RETP, RET2P and SUE). We also see a strong correlation of growth measure (as measured by earning-to-price ratio) and accruals with future returns. However, we find no significant relationship between size and future returns. These

results suggest that the bias towards momentum stocks is likely to work in favour of investors whereas the bias towards growth stocks is likely to work against them.

In order to aggregate growth and value characteristics, we combined these measures to form a new scoring system. First, each stock was binarily coded as 1 or 0 in relation to median values as shown in column 3. As used in previous studies, including Azzi and Bird (2005), our scoring system is based on accepted relationships in the literature which show that a positive association of bianry variables with future returns can be expected. From the analysis of these binary measures, we find positive correlations of binary variables with RETP, RET2P, ETOP and ACCRUAL. However, there is a negative correlation of binary variables for SIZE with future returns. In order to measure the effectiveness of each strategy, the mean net portfolio return, defined as the mean difference in future returns between the top performing (represented by a binary score of 1) firms and the bottom performing firms (represented by a binary score of 0) over 59 months were calculated. The results are reported on the second-last column of Table 7-3. These results show that momentum strategy is likely to offer significant returns with both RETP and RET2P, indicating the profitability of this strategy. Similarly, portfolio formation by earning-to-price and accruals strategies also yield significantly positive returns. However, market value strategy produced a significantly negative mean net return.

Table 7-3: Investment Signals and Future Returns

This table reports correlations between returns and the continuous explanatory variable. A binary variable is developed to each explanatory variable depending on its value with respect to median values. % Positive includes the percentage of variables that are allocated the value of 1. Binary correlation is measured by the Pearson correlation of the binary variable with returns. Net portfolio return is the mean difference in future returns between the portfolio of top and bottom firms within each variable. % Positive portfolio returns reports the percentage of the semi-annual periods in which the net portfolio return was above 0.

Explanatory Variable	Continuous explanatory variable	Definition	% Positive	Binary correlation	Mean net portfolio return	% Positive portfolio returns
RETP	0.031897 ***	1 if greater than median, 0 otherwise	68.33%	0.0356959 ***	0.0112 ***	42.94%
RET2P	0.043836 ***	1 if greater than median, 0 otherwise	53.33%	0.0165293 ***	0.0044 *	40.44%
SUE	0.036427 ***	1 if greater than median, 0 otherwise	46.67%	-0.002868	0.0168 *	2.69%
BMRAT	-0.00694	1 if greater than median, 0 otherwise	50.00%	0.0018585	0.0010	41.97%
ETOP	0.060019 ***	1 if greater than median, 0 otherwise	63.33%	0.0575022 ***	0.0185 ***	42.35%
SGROWTH	-0.00103	1 if greater than median, 0 otherwise	51.67%	-0.001472	-0.0038	29.45%
ACCRUAL	0.057991 ***	1 if greater than median, 0 otherwise	65.00%	0.024899 ***	0.0081 ***	32.26%
SIZE	0.007993	1 if greater than median, 0 otherwise	40.00%	-0.010999 **	-0.0026	43.68%

*,**,*** indicate statistical significance at 10%, 5% and 1% level respectively.

7.5.4 Aggregated Variables

We now combine the binary values of each variable to come up with an aggregated measure, called the Qscore. The 'Qscore' is calculated as the sum of eight binary investment signals. 'Momentum' is calculated as the sum of three momentum signals and and 'Contrarian' as the sum of the remaining five investment signals. Qscore, momentum and contrarian measures are all found to be significantly and positively correlated with future returns. These positive relationships are further analysed in Panels B, C, and D below. Firms are sorted into portfolios according to the sums of their binary scores within each summary measure. Our expectation is that

portfolios with higher scores in any of the summary measures will yield a greater return than portfolios with lower scores. We find a significant and positive return differential between the best and worst performing portoflios. The Qscore portfolio offers a return of 1.38% per month followed by momentum strategy (1.15%) and contrarian strategy (0.5%).

Table 7-4: Summary measures and future returns

Panel A of this table reports correlation between future returns and the summary measures. Panel B, C and D report performance of the portfolios grouped according to the summary measure ratings. Summary measures are created from the binary variables of individual explanatory variables. Qscore is calculated as the sum of the eight binary investment signals. Momentum is calculated as the sum of the three momentum signals. Contrarian is calculated as the sum of the remaining five investment signals.

Panel A: Pearson correlation with future returns	
Summary measure	Correlation
Qscore	0.0426 ***
Momentum	0.0339 ***
Contrarian	0.0306 ***

Panel B:Market-adjusted returns by Qscore rating	
Qscore	Mean
Best = 8,7,6	0.0064
Medium=5,4	0.0028
Worst=3,2,1,0	-0.0084
BEST-WORST	0.0138 **

Panel C: Market-adjusted returns by momentum rating	
Momentum	Mean
Best = 2,3	0.0067
Medium=0,1	-0.0060
BEST-WORST	0.0115 ***

Panel D: Market-adjusted returns by Contrarian rating	
Contrarian	Mean
Best = 3,4,5	0.0012
Medium=0,1,2	-0.0038
BEST-WORST	0.0050 **

*,**,*** indicate statistical significance at 10%, 5% and 1% level respectively.

7.5.5 Incremental Values of Message Board Recommendations

We now control for the predictive variables and aggregate scores based on these variables to analyse the incremental values provided by message board recommendations. We use three different regression models and present the results in Table 7-5 below. Model A1 represents the regression of future returns with consensus recommendations only. We use Qscore and message board recommendation measures in Model A2 . Model A3 represents the regression of future returns with message board recommendations and the binary values of each predictive variable. From all three regression models, we find that consensus recommendation level does not have a significant relation to future returns. This suggests that consensus recommendations derived from message board postings alone are unlikely to add any incremental value to investment decisions.

Table 7-5: Message Board Activity and Excess Returns

This table reports regression results of panel data with a fixed effect on message board activity and excess returns. The dependent variable is future excess return. Model A1(B1) reports a regression of returns on recommendation (changes). Model A2 (B2) reports a regression of returns on recommendations (changes) and Qscore. Model A3(B3) reports a regression of returns on recommendations (changes) and eight binary variables. Model A4 (B4) reports a regression of returns on the recommendations (changes) and actual values of eight explanatory variables.

	Model A1: Message Board Alone		Model A2: Message Board and Qscore		Model A3: Message Board and Binary	
	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat
Panel A: Consensus Recommendation Level (RECO)						
Intercept	-0.011	-4.77 ***	-0.010	-1.41	-0.005	-0.63
RECO	0.021	0.68	0.021	0.69	0.039	1.28
QSCORE			-0.033	-0.15		
RETP					0.013	2.79 ***
RET2P					-0.010	-2.22 **
SUE					-0.059	-4.61 ***
BMRAT					0.004	0.68
ETOP					0.049	6.15 ***
SGROWTH					0.040	0.07
ACCRUAL					0.026	3.41 ***
SIZE					-0.067	-8.07 ***
R-squared		0.059		0.059		0.075
Observations		8971		8971		8971
F-statistic		0.90		0.90		1.14 **
Panel B: Consensus Recommendation Change (RECCHG)						
Intercept	-0.007	-2.47 **	-0.007	-0.97	-0.003	-0.38
RECCHG	-1.145	-2.34 **	-1.146	-2.35 **	-1.007	-2.08 **
QSCORE			0.016	0.07		
RETP					0.013	2.87 ***
RET2P					-0.010	-2.13 **
SUE					-0.059	-4.64 ***
BMRAT					0.005	0.83
ETOP					0.049	6.15 ***
SGROWTH					0.085	0.16
ACCRUAL					0.026	3.44 ***
SIZE					-0.065	-7.77 ***
R-squared		0.060		0.060		0.075
Observations		8916		8916		8916
F-statistic		0.90		0.90		1.13 **

*,**,*** indicate statistical significance at 10%, 5% and 1% level respectively.

In Panel B, our regression results for future returns with recommendation change as a proxy of message board activity show some significant relationship with returns. The results show that coefficients of recommendation changes are now significant and negative in all three models. Unlike analyst recommendation changes, as in Azzi and Bird (2005), who find a positive association between broker recommendationd changes to future returns, our results suggest that if consensus recommendations are upgraded, share price is likely to decline and if consensus recommendations are downgraded, share prices are likely to rise. These results suggest that upgrades in message board recommendations are likely to have negative correlation to future returns and recommendation downgrades are likley to have positive correlation to future returns. Further, this finding holds true with and without control for biases.

7.5.6 Sub-period Analysis

Since our study period ranges from the beginning of calendar year 2004 through to the end of 2008, our dataset provides an opportunity to study upturn and downturn phases on the Australian share market. The results we obtained could have different implications in each of these sub-periods. As such, we re-assessed our findings on the determinants of message board activity and its effect on share prices to find out whether message board activity had differing impacts in the two sub-periods. We divided our data range into market upturn (January 2004 to October 2007) and market downturn (November 2007 to December 2008). Using the same regression models as in Table 7-1 and the variables defined in previous sections, we present our results in Table 7-6 below. We found that the contribution of our predictive variables such as book-to-market ratio and size to investors' message board discussions was greater during the market upturn than during the downturn. Our previous findings from the whole period,

which was that investors prefer momentum, growth and larger firms, were more pronounced during the upturn than during the downturn.

Table 7-6: Sub-period analysis on Determinants of Message Board Activity

This table reports regression results on panel data with fixed effects. The sample data was divided into two categories –the market upturn and the market downturn – depending on performances of the All Ordinaries Index. The dependent variables in Panels A and B are consensus recommendation level and consensus recommendation changes respectively. Consensus recommendation is calculated from the messages posted over the last week of each month. RETP is past 3-month's (i.e. t-1 to t-4) returns and RET2P is returns over t-4 to t-6 months. SUE is standardised unexpected earnings. BMRAT is the ratio of book-value to the market value of firm. ETOP, SGROWTH and ACCRUAL are earning to price, sales growth and accrual to total assets for each stock at the time of consensus recommendation. SIZE is the natural log of market capitalisation of firms at the end of each month.

Panel A: Consensus Recommendation level				
	Market Upturn		Market Downturn	
Variable	Coeff.	t-stat	Coeff.	t-stat
Intercept	2.321	16.83 ***	2.848	12.96 ***
Momentum variables				
RETP	0.335	1.43	0.074	0.21
RET2P	0.412	1.78 *	-0.652	-1.57
SUE	-0.121	-1.59	-0.065	-0.50
Contrarian variables				
BMRAT	-0.885	-2.05 **	-0.001	-1.32
ETOP	-0.463	-0.65	-0.797	-0.74
SGROWTH	-0.156	-0.21	0.027	0.24
ACCRUAL	-0.167	-0.81	0.351	0.35
SIZE	0.045	3.13 ***	0.006	2.35 **
Observations		1091		502
R-squared		0.436		0.638
F-statistic		2.91 ***		2.66 ***
Panel B: Consensus Recommendation Change				
Intercept	0.314	9.17 ***	0.301	4.61 ***
Momentum variables				
RETP	0.156	2.67 ***	0.060	0.58
RET2P	0.063	1.09	-0.118	-0.96
SUE	0.874	0.46	0.034	0.86
Contrarian variables				
BMRAT	-0.022	-0.21	0.070	0.64
ETOP	-0.179	-1.02	-0.239	-0.75
SGROWTH	-0.068	-0.37	0.034	1.01
ACCRUAL	-0.052	-1.01	0.055	0.19
SIZE	0.089	0.25	0.000	0.34
Observations		1091		502
R-squared		0.217		0.337
F-statistic		1.04		0.77

*,**,*** indicate statistical significance at 10%, 5% and 1% level respectively.

In exploring whether message boards add investment value, we found that consensus recommendation level contributed to future returns during the market up-turn only. Consistent with our previous findings, recommendation changes were negatively related to future returns during both the upturn and the downturn. However, the significance of the relationship was obvious during market upturn only, suggesting that participants in message boards are likely to herd after the event (i.e. they respond to what has happened in the market) and this explains the negative coefficient on recommendation change. Not surprisingly, this phenomenon is much more obvious when markets are trending upwards than in downturn markets. The recommendations seem to be highly correlated with future performance during market upturns and the negative correllation with changes seems to be stronger in down markets.

Table 7-7: Sub-period Analysis on Message Board Activity and Excess Returns

This table reports regression results of panel data with fixed effects. Sample data was divided into two categories – during market upturn and market downturn – depending on performances of the All Ordinaries Index. The dependent variable is future excess return. Model A1(B1) reports a regression of returns on recommendation (changes). Model A2(B2) reports a regression of returns on recommendations (changes) and Qscore. Model A3(B3) reports a regression of returns on recommendations (changes) and eight binary variables. Model A4 (B4) reports a regression of returns on the recommendations (changes) and actual values of eight explanatory variables.

	Model A1: Message Board Alone		Model A2: Message Board and Qscore		Model A3: Message Board and Binary Signals	
	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat
Panel A: Consensus Recommendation Level (RECO) : Market Upturn						
Intercept	0.008	3.36 ***	0.009	1.14	0.003	0.32
RECO	0.398	1.40	0.400	1.41	0.000	1.69 *
QSCORE			-0.029	-0.11		
RETP					0.319	0.61
RET2P					-0.010	-1.91 *
SUE					-0.052	-3.40 ***
BMRAT					0.021	2.68 ***
ETOP					0.048	4.57 ***
SGROWTH					0.366	0.60
ACCRUAL					0.025	2.69 ***
SIZE					-0.050	-4.82 ***
R-squared		0.076		0.076		0.090
Observations		5791		5791		5791
F-statistic		0.89		0.88		1.04
Panel B: Consensus Recommendation Level (RECO) : Market Downturn						
Intercept	-0.037	-3.87 ***	-0.008	-0.44	-0.019	-0.88
RECO	-0.293	-1.11	-0.304	-1.15	-0.204	-0.77
QSCORE			-0.009	-1.83 *		
RETP					-0.009	-0.88
RET2P					-0.028	-2.84 ***
SUE					-0.067	-2.86 ***
BMRAT					0.030	1.69 *
ETOP					0.042	2.23 **
SGROWTH					0.086	0.08
ACCRUAL					0.023	1.29
SIZE					-0.071	-3.37 ***
R-squared		0.137		0.138		0.150
Observations		3180		3180		3180
F-statistic		0.86		0.87		0.94

Panel C: Consensus Recommendation Change (RECCHG): Market Upturn						
Intercept	0.013	4.24 ***	0.012	1.39	0.004	0.41
RECCHG	-0.011	-1.93 *	-0.011	-1.93 *	-0.010	-1.69 *
QSCORE			0.035	0.13		
RETP					0.367	0.70
RET2P					-0.010	-1.85 *
SUE					-0.053	-3.44 ***
BMRAT					0.022	2.81 ***
ETOP					0.050	4.64 ***
SGROWTH					0.443	0.72
ACCRUAL					0.025	2.66 ***
SIZE					-0.047	-4.47 ***
R-squared		0.076		0.076		0.089
Observations		5736		5736		5736
F-statistic		0.88		0.88		1.03

Panel D: Consensus Recommendation Change (RECCHG): Market Downturn						
Intercept	-0.045	-8.44 ***	-0.017	-1.01	-0.024	-1.23
RECCHG	-0.388	-0.42	-0.004	-0.45	-0.003	-0.33
QSCORE			-0.009	-1.82 *		
RETP					-0.873	-0.89
RET2P					-0.028	-2.83 ***
SUE					-0.066	-2.84 ***
BMRAT					0.030	1.72 *
ETOP					0.042	2.27 **
SGROWTH					0.087	0.08
ACCRUAL					0.023	1.30
SIZE					-0.072	-3.41 ***
R-squared		0.137		0.138		0.150
Observations		3180		3180		3180
F-statistic		0.86		0.87		0.94

*,**,*** indicate statistical significance at 10%, 5% and 1% level respectively.

7.6 Conclusion

In this chapter, we have examined what determines the stock preferences investors express on message boards and the role of message board recommendations on future stock returns. By using message board data from *HotCopper*, we studied eight variables representing the momentum, growth, valuation and size of the firms to determine inherent biases in message board recommendations. Two proxies for message board recommendations – recommendation level and recommendation change – were regressed against eight investment signals as a panel data set. By using binary coding, we examined the predictive ability of these eight investment signals separately and on

an aggregated score as well. In order to examine the role of message board recommendations during different market conditions, we divided our sample into two sub-periods (i.e. market upturn and market downturn).

We find evidence to suggest that investors are likely to favour growth firms, larger firms and firms with recent share price momentum. Changes in consensus recommendations on message boards are positively related to share price momentum. After controlling for potential biases in message board recommendations, we find that consensus recommendations did not add any value to investment decisions. Consensus recommendation changes, however, showed a significantly negative relationship with future returns. The division of our sample into two different sub-periods, market upturn and downturn, revealed that recommendations seem to be highly correlated with future performance during market upturns and the negative correllation with changes seems to be stronger in down markets.

However, the negative relationship between recommendation changes and returns was pronounced during the market upturn only. Our finding suggest that participation in message board discussions is not likely to add any investment value.

Chapter VIII: Stock Message Board and Investors' Reaction to Company News

8.1 Introduction

The empirical works presented in the previous chapters show some evidence that message board variables are associated with trading variables, trading volume and share price volatility in particular. Previous chapters focused on establishing a link between the activity on message boards and stock trading, and on examining the extent to which the stock message boards either predict or reflect the market. Our focus in this chapter is slightly different in that we concentrate on how message board recommendations are made around the days with information events and how these recommendations bring changes to firms' informational environments (such as volatility, liquidity etc.).

Using unscheduled price-sensitive company announcements as information events, we examined the relationship between message board activity and stock price reactions to these events. In this paper, we focus on four main questions related to stock message board activity around the release of company news: (1) Are stock forum participants aware of the timing of news arrivals? (2) Does the way investors react to company announcements vary systematically with the level of message board activity? (3) Do message boards contribute to post-announcement drifts in stock prices? and (4) How do stock message boards contribute to firms' informational environments?

By using the message board data from *HotCopper*, share price data from DataStream and company news data from SIRCA, we performed a series of event studies, regression analyses and univariate comparisons. We observed an elevated level of message board activity prior to unscheduled announcements. Our findings suggest

that stock message board participants could be aware of announcement timing and discussions held prior to it could be speculation about the contents of those announcements. Consistent to our findings in the previous chapters, the number of messages after the event is generally greater than that before the event, suggesting that message board participants follow rather than lead the stock market. We observed that negative message board activity was associated with share price reactions to negative news events and that positive activity was associated with share price reactions to positive news events. We also found that contemporaneous message posting activity positively contributed to post-announcement drifts. We did not find any obvious effect of stock message boards on firms' informational environments (such as changes in volatility, liquidity etc.) although volatility increased on days around positive and negative information events and liquidity decreased following negative news.

The rest of the chapter proceeds as follows. Section 2 establishes the research context by reviewing related literature. Section 3 describes the sample firms, financial and message board data and other variables used in the study. Section 4 describes the design and methods used in the study. The empirical findings are presented and discussed in Section 5 with Section 6 offering the conclusion to this study.

8.2 Literature Review

While the extant message board literature agrees that the stock market responds to messages posted on stock forums, these studies focus on examining the predictive power of message board activity. Academics have started researching behavioural issues associated with message posting (Park et al. 2010) and developing sophisticated techniques to capture the information content on message boards (Hvistendahl & Chen 2009). Message boards play a role in transmitting information to the market and as

such, message board patterns around days with new releases are of academic interest. However, the study on the nature and impact of message board activity on stock markets around company-specific news events has received less attention. We study the message volume and corresponding recommendations on days around unscheduled company news in order to examine the extent to which forum participants expected the timing of the news arrival. This study also allows us to examine whether message board activity causes systematic variations in market reactions to such news events. We review some prior studies that are related our work in the subsequent paragraphs.

8.2.1 Message Board Effect on Market Response to Company News

A significant volume of the existing literature examines the response of stock price to unexpected news in earning announcements. A summary of these works, as documented in Lev (1989), points to the fact that unexpected earnings and stock price responses are significantly related. Other studies (such as Lee (1992a), Lee (1992b), Bhattacharya (2001), Asthana, Balsam & Sankaraguruswamy (2004) and Lerman (2010)) support the view that individual investors react strongly to information releases. However, only a few studies relate message board activity to firms' information releases. For example, Wysocki (1999) reports an increase in message board activity around earning announcements and finds an association with contemporaneous changes in daily trading volume, stock returns and prior day stock returns. Similarly, a recent study by Lerman (2010) reports individual investors paying considerable attention to accounting information and observes a significant increase in accounting-related discussion around earning releases, periodic reports and 8-K reports. This study also finds a reduction in information asymmetry and hence, that a reduction in post-earning

announcement drift is associated with higher accounting-related discussion around earnings announcements.

Prior studies have offered us an opportunity to examine the influence of message boards on retail investors' expectations as stock forum participants can serve as a proxy for individual investors (Lerman 2010) and day traders (Zhang & Swanson 2010). However, focusing on earning announcements only can result in highly discussed smaller firms being overlooked. Companies favoured by message board participants generally tend to be growth and young companies at an early stage in their business cycle and this is reflected in our sample with a significant proportion of sample firms yet to report profits to their shareholders. Our focus in this study was to observe the message board pattern in its responses to unscheduled information events. The SIRCA dataset has a dedicated category of 'Progress Report' that includes announcements such as joint-venture agreements and winning work contracts. Another reason for considering unscheduled announcements was to make our sample more representative by including smaller firms. Furthermore, to the best of our knowledge, little or no studies have previously been done along these lines. In addition, message board activity and investors' reactions to unscheduled news could vary depending on news types. In this study, we also categorise positive and negative news events based on the initial market reaction and examine the impacts of these events separately.

8.2.2 Stock Message Boards and Changes to the Informational Environment

In addition to association with stock returns and trading volume, message board discussions could also affect firms' share price volatility and liquidity as a result of company news releases. While the release of unscheduled company news gives investors new pieces of information, it also introduces a degree of uncertainty about

future events. Corporate news, if it increases valuation uncertainty, would result in less trading (Yeung & Bird 2010). This uncertainty about the future could bring changes in firms' share price volatility as investors are likely to revise their prior beliefs and adjust their future expectations. For example, Clayton, Hartzell and Rosenberg (2005) find that share price volatility increases following a CEO turnover and that the increase is more in cases of forced turnovers than in voluntary turnovers. Another study by Kliger and Sarig (2000) report that unexpected rating announcements by Moody's result in changes in volatility.

In cases of liquidity, there is evidence that stocks' liquidity changes around corporate news events. For example, bid-ask spreads decline when buyback schemes are announced (Singh, Zaman & Krishnamurti 1994). Similarly Kothare (1997) reports that rights issue offerings are followed by a significant increase in proportionate bid-ask spreads after the ex-date. Similarly, proportionate bid-ask spread is decreased for firm commitment offerings. A similar study of bid-ask spread by Hegde and McDermott (2003) reports that actual and relative bid-ask spreads are reduced when the firms are included in the Index. So, changes in liquidity can be expected when announcement are made, and the direction of the change will depend on whether the announcement is positive or negative. It is unclear however, whether the message board discussion contributes to valuation uncertainty and information asymmetry. In this study, we examine changes in stock return variances and volatility on days around corporate news releases.

Our study complements the current literature in three ways. First, we study message board activity around the release of unscheduled company announcements. Second, we examine whether stock price reactions to company announcements vary

systematically with the level of message board activity. And finally, we investigate how message boards contribute to firms' informational environments.

8.3 Research Data and Sample Description

We used 764 firms listed on the ASX for this study and the detailed description of sample firms, data sources and a summary of the statistics of firms used in our study was presented in Chapter 3 – Research Design.

The Australian continuous disclosure regime, as regulated by the *Corporations Act 2001 (Commonwealth)*[8] and the Australian Stock Exchange listing rules[9], require all ASX-listed public companies to immediately disclose price-sensitive information to the market. We obtained the records of such announcements from SIRCA and used only price-sensitive news in our study. The SIRCA database records company news under 19 different categories such as Takeover Announcements and Dividend Announcements. However, given the unexpected timing of news announcements, we studied news from the 'Progress Report' category only. We ensured that we had enough observations in this category to perform statistical tests. Announcements such as joint venture agreements, and announcements dealing with the winning of work contracts are recorded under this category. The timing of these events may not be completely unscheduled. As Bird, Grosse and Yeung (2010) suggest, even the information in exploration, resource and reserve announcements of mining comments is anticipated by the market. However, the timing of these announcements is less certain than other announcements such as earning announcements. Any announcement released on non-trading days (i.e. Saturdays, Sundays, and public holidays) was assigned to the next trading day. We made our events free from contaminated news by excluding

[8] Section 674, Chapter 6CA Continuous Disclosure, *Corporations Act 2001 (Commonwealth)*.
[9] ASX Listing Rule 3

observations that had any other price-sensitive news within a 13-day window (i.e. *t-6* to *t+6*, with *t* being the event day). We classified information event days into different categories based on the initial market response to the news. By computing cumulative returns over [0,+1], we classified the news into positive (if the CAR was greater than +0.5%), neutral (if the CAR was between -0.5% and +0.5%) and negative (if the CAR was less than -0.5%).[10]

8.4 Research Methods

We used an event study methodology to study the message board activity around company news release events. Based on message volume, we employed univariate comparison and multivariate regression equations. The details of these methods are presented below.

8.4.1 Event Study Methodology

When price-sensitive news is released by the company, we define this as the event day. Message board activity is examined over a 10-day window around the release of company announcements. The number of messages posted and the sentiments expressed were used as proxies for message board activities. The level of abnormal message board activity is defined as the difference between the message posting variable such as the number of message posted and the expected value (i.e. normal value) of the variable. Given that the distribution of our time-series data of message posting volume was skewed to the left, we normalised the series by log-transforming the values before testing by statistical methods. Following Campbell and Wasley (1996), an abnormal level of message volume is then defined as:

[10] We categorised the news by using other returns such as 0.25%, 0.75% and 1%. We also used tercile measures to classify the news into positive, negative and neutral groups. Our results did not change much and for the sake of brevity, we only report the results obtained by using the 0.5% benchmark.

Abnormal message volume, $AV_{it} = LV_{it} - E[LV_{it}]$, ...(8.1)

where, $LV_{it} =$ Natural log transformed volume, i.e. $LV_{it} = \ln(1 + V_{it})$ with V_{it} being the actual message volume for firm *'i'* on day *'t'*. $E[LV_{it}]$ is the expected value of actual message volume (or normal volume) and which is an average of message volume over the last 250 days starting from *'t-6'* day. This is computed as:

$$E[LV_{it}] = \frac{\sum_{t=-6}^{t=-131} \ln(1 + V_{it})}{125} \quad \text{.....(8.2)}$$

8.4.2 Univariate Comparisons and Multivariate Regressions

We studied the stock price reaction to company news for different levels of message posting activity. The sample firms were classified into 'with' and 'without' message posts by using a five-day moving average that included the postings up to two days prior to announcements (i.e. *t-7* to *t-2*=5 days). For events with message board activity (i.e. message volume, recommendation values and recommendation changes) prior to company news, we further classified them into 'High level', 'Medium level' and 'Low level' message board activity terciles. Stock price reactions to company news were measured by using cumulative excess return over the event window of [0,+1] from the market return, where the All Ordinaries Index was used as the proxy for market portfolio. We performed multivariate estimates of the relationships of excess event return, post-announcement return, and abnormal trading volume to message board variables and control variables based on the following models:

Excess return:

$$AR_{it} = \alpha_0 + \alpha_{t1} MessageBoardVariable + \alpha_{t2} Size + \alpha_{t3} BMRatio + \alpha_{t4} Momentum + \alpha_{t5} Volatility$$
.....(8.3)

Excess post-announcement return:

$$Post\_AR_{it} = \alpha_0 + \alpha_{t1} MessageBoardVariable + \alpha_{t2} Size + \alpha_{t3} BMRatio + \alpha_{t4} Momentum + \alpha_{t5} Volatility + \alpha_{t6} AR_{it}$$

.....(8.4)

Abnormal trading volume:

$$AbVol_{it} = \alpha_0 + \alpha_{t1} MessageBoardVariable + \alpha_{t2} Size + \alpha_{t3} BMRatio + \alpha_{t4} Momentum + \alpha_{t5} Volatility + \alpha_{t6} AR_{it}$$

.....(8.5)

Where,

AR_{it} = Cumulative excess return over 2-day window [i.e.0,+1];

$Post\_AR_{it}$ = Cumulative excess return over 5-day post-event period [i.e. +2,+6]

$Abvol_{it}$ = the difference between daily log volume (i.e. logarithm of 1 plus daily volume) and the average log volume on days '-131' to '-6'.

$MessageBoardVariable$ = Messages and Recommendation values regressed separately.

'Pre-event Messages' is the natural logarithm of 1 plus the cumulative number of messages posted over the five days prior to the company announcement. 'Event Message' is the cumulative number of messages posted over [0,+1]. 'Pre-event Sentiment' is the recommendation values averaged over the five days prior to the company announcement (i.e. from +6 to +1. 'Event sentiment' is the average recommendation value over [0,+1].

$Size$ = the natural logarithm of market value of equity as at the end of the month prior to when the announcement was made.

$BMRatio$ = the ratio of book value to market value of equity 30 days before the announcement.

$Momentum$ = previous month's stock return.

$Volatility$ = realised volatility, measured using daily data without Newey-West correction in over the last 20 days relative to 't-1' (i.e. from t-20 to t-1).

8.4.3 Changes in Volatility and Liquidity

We further examined the impact of news arrivals on firms' informational environments in the presence of message board activity. We investigated volatility and liquidity on days '-1' through to '+3' following company announcements for firms with different levels of message board activity. The categories of levels were: Messages, No messages, High messages and Low messages. For each sub-category, we calculated the ratio of volatility and liquidity measures on that date to the average value of the measure during the estimation period (i.e. days -131 to -6). According to the null hypothesis unscheduled news arrival has no effect on share trading, and the ratios of volatility and liquidity on the days around the company news will be equal to its long term historical average. Formally, the null hypothesis is stated as:

Variance of stock returns:

$$H_0 : E[R_{it}^2] / E[R_{est}^2] = 1$$

where $E[R_{it}^2]$ denotes square of excess return on the days around company news and $E[R_{est}^2]$ denotes average of squared excess return over estimation period. Squared excess returns are used as a measure of variance of stock returns as it can be approximated as $Var[R_\delta] = E[R_\delta^2].\delta$ (Ohlson & Penman 1985).

Illiquidity:

$$H_0 : Illiq_{it} / Illiq_{est} = 1 = 1$$

where $Illiq_{it}$ and $Illiq_{est}$ denote illiquidity measures on days around company news and over the estimation period respectively. We use the illiquidity measure suggested by

Amihud (2002), which proxies the illiquidity as the ratio of the absolute daily stock return to its dollar trading volume. Illiquidity for stock *i* on day *t* is then given by:

$$Illiq_{it} = \frac{\left|R_{i,t}\right|}{\$Volume_{i,t}}$$

where $R_{i,t}$ and $\$Volume_{i,t}$ are return and dollar trading volume for stock *i* on day *t* respectively.

8.5 Empirical Results

8.5.1 Are Stock Forum Participants Aware of the Timing of News Arrivals?

We report the event study results for message board activity around the release date of company announcements in Table 8-1. The results in Panel A show abnormal levels of message posting volume over the 10-day window around the release of the company news. The results show that there are significantly elevated levels of abnormal message posting volume and positive recommendation values pre- and post- positive and negative news events. In cases of neutral news events however, elevated levels of message board activity subside by day 0. The presence of elevated levels of message board activity prior to all news events suggests that news events are anticipated by the stock forums. Forum participants might be aware of the timing of news arrivals but only positive and negative events will result in above normal discussion on the forum post-announcement. One interesting observation we note in the case of negative events is that the mean values of message board variables are higher for pre-announcement periods than for post-announcement periods whereas in cases of positive events, it is the other way around. This pattern suggests that while positive and negative news events are preceded by higher message volume, positive events are likely to attract more followers than negative news events.

Table 8-1: Abnormal Message Board Activity around Company Announcements

This table reports abnormal levels of messages postings and sentiments expressed around the company announcements. Announcement events are further classified into negative, neutral and positive news events based on the cumulative excess return over the [0, +1] window. The level of abnormal message board activity is defined as the difference between the daily value of a variable used to measure the activity level and the average values of the measure on days -131 to -6.

Day	Negative News			Neutral News			Positive News		
	Mean	N	t-stat	Mean	N	t-stat	Mean	N	t-stat
Panel A: Abnormal Number of Messages									
-5	0.122	7715	12.93 ***	0.042	1834	2.54 **	0.102	9033	12.36 ***
-4	0.105	7715	11.18 ***	0.041	1834	2.50 **	0.089	9033	10.63 ***
-3	0.120	7715	12.47 ***	0.031	1834	1.81 *	0.094	9033	11.24 ***
-2	0.144	7715	14.90 ***	0.033	1834	1.91 *	0.104	9033	12.26 ***
-1	0.161	7715	16.11 ***	0.049	1834	2.96 ***	0.155	9033	17.78 ***
0	0.380	7715	37.19 ***	0.214	1834	12.37 ***	0.567	9033	57.32 ***
1	0.117	7715	12.33 ***	-0.009	1834	-0.60	0.292	9033	31.12 ***
2	0.090	7715	9.62 ***	0.013	1834	0.77	0.187	9033	20.37 ***
3	0.093	7715	9.81 ***	0.036	1834	2.21 **	0.141	9033	15.59 ***
4	0.082	7715	8.61 ***	0.019	1834	1.11	0.143	9033	15.87 ***
5	0.095	7715	9.88 ***	0.046	1834	2.63 ***	0.160	9033	17.66 ***
Panel B: Abnormal Recommendation Level									
-5	0.076	7715	10.89 ***	0.024	1834	1.88 *	0.067	9033	10.73 ***
-4	0.057	7715	8.15 ***	0.018	1834	1.46	0.053	9033	8.67 ***
-3	0.070	7715	9.80 ***	0.033	1834	2.49 **	0.057	9033	9.23 ***
-2	0.084	7715	11.63 ***	0.031	1834	2.28 **	0.067	9033	10.74 ***
-1	0.093	7715	12.62 ***	0.025	1834	1.97 **	0.094	9033	14.75 ***
0	0.204	7715	26.78 ***	0.139	1834	9.98 ***	0.352	9033	48.46 ***
1	0.052	7715	7.33 ***	-0.016	1834	-1.29	0.194	9033	28.46 ***
2	0.049	7715	6.96 ***	0.017	1834	1.34	0.123	9033	18.17 ***
3	0.055	7715	7.81 ***	0.035	1834	2.74 ***	0.100	9033	15.06 ***
4	0.051	7715	7.22 ***	0.017	1834	1.31	0.175	9033	2.25 **
5	0.055	7715	7.63 ***	0.021	1834	1.63	0.096	9033	14.47 ***

*,** and *** are statistically significant at 10%,5% and 1% respectively.

8.5.2 Does the Way Investors React to Company Announcements Vary Systematically with the Level of Message Board Activity?

We examined the stock price response over a two-day window (i.e. days 0 to +1), and related this return to message board variables and firm characteristics. Table 8-2 reports the univariate comparison of two-day cumulative excess returns on announcement days. In order to see how pre-event discussions are likely to impact on investors' reactions to company news, we first classified the firms into 'with' and 'without' pre-event messages.[11] For the events with pre-event messages, we further divided these into high, medium and low message volume.

[11] We use five-day moving averages to identify firms with high, medium and low levels of message volume.

Table 8-2 : Message Board Activities and Stock Price Reactions to Company News

This table reports the cumulative excess return over the [0,+1] and [+2,+6] windows relative to the release of company news. The sample firms were first divided into 'Messages' and 'No Messages' based on the 5-day moving average of the number of messages posted as at 't-1'. The events with messages board postings are further subdivided into 'High discussion', 'Medium discussion' and 'Low discussion' terciles. Only the comparison between the high and low terciles is reported here.

Panel A: Announcements with and without Prior Messages							
	Messages		No Messages		Msg - No	t-stat	
	Mean	N	Mean	N	Msg		
Cumulative Excess Return [0,+1]							
Negative News	-5.33%	5857	-4.59%	2309	-0.73%	-5.07	***
Neutral News	-0.02%	1246	-0.03%	734	0.01%	1.10	
Positive News	6.35%	6515	5.89%	3009	0.46%	2.96	***
Cumulative Excess Return [+2,+6]							
Negative News	-0.39%	5857	0.23%	2309	-0.62%	-2.81	***
Neutral News	-0.27%	1246	-0.21%	734	-0.06%	-0.17	
Positive News	-0.81%	6515	-0.61%	3009	-0.19%	-0.93	
Panel B: Announcements with High and Low number of messages prior to the event							
	High		Low		High -	t-stat	
	Mean	N	Mean	N	Low		
Cumulative Excess Return [0,+1]							
Negative News	-6.38%	1935	-4.60%	1768	-1.78%	-7.52	***
Neutral News	-0.01%	390	0.00%	397	0.00%	-0.22	
Positive News	7.14%	2169	5.77%	2151	1.37%	6.26	***
Cumulative Excess Return [+2,+6]							
Negative News	-1.23%	1935	0.02%	1768	-1.25%	-3.41	***
Neutral News	-0.55%	390	-0.79%	397	0.24%	0.43	
Positive News	-0.72%	2169	-0.63%	2151	-0.09%	-0.27	
Panel C: Announcements with High and Low recommendation level prior to the event							
	High		Low		High -	t-stat	
	Mean	N	Mean	N	Low		
Cumulative Excess Return [0,+1]							
Negative News	-6.20%	1952	-4.93%	1862	-1.27%	-5.32	***
Neutral News	-0.01%	415	-0.03%	320	0.01%	0.70	
Positive News	6.95%	2172	5.99%	2172	0.96%	4.14	***
Cumulative Excess Return [+2,+6]							
Negative News	-0.98%	1952	-0.20%	1862	-0.79%	-2.18	**
Neutral News	-0.57%	415	-0.26%	320	-0.31%	-0.54	
Positive News	-0.98%	2172	-0.75%	2172	-0.23%	-0.67	

*,** and *** are statistically significant at 10%,5% and 1% respectively.

The results in Panel A suggest that for news events for which there was prior discussion on stock forums, the market response is dependent on the type of news. For positive news, events with prior messages produce significantly higher (0.46%) returns than those without any prior discussion. In cases of negative news, events with prior discussion perform worse (-0.73%) than events without any message board following. The same types of relationships also hold true for high and low levels of message board activity events.

We report multivariate regression outputs for excess returns on company news in Table 8-3. The dependent variable is the cumulative excess returns over a two-day window [i.e. 0,+1], which is then regressed against message board variables and firm characteristics that are considered to be important in describing excess returns. We used message-related and firm-related control variables in our regressions. We included firm size (measured by the log of market value of equity) because reactions to news could be stronger for small-sized firms than that for firms with large market capitalisation. We also included the book-to-market ratio because firms with low book-to-market ratios are likely to be growth companies and news about these firms may have caused investors to increase/decrease future growth expectations. This may have resulted in investors reacting differently to firms with different book-to-market ratios. The regression also includes past month return (as a proxy for momentum) and volatility (measured by realised volatility over the last 20 days as up to *'t-1'*, with *'t'* being the event day) in share prices. We report the regressions output for positive (on Panel A) and negative (on Panel B) events only, because stock forum discussions are not affected by neutral news events.

The first and second columns of Table 8-3 report the estimation outputs when message volume and recommendations are used separately in the regression as

described in the previous section. Regression estimates support our univariate finding that pre-event discussions are positively related to returns for positive news events whereas they are negatively related to returns for negative news events. Even after controlling for firm size, growth and share price characteristics, the message board variables prior to announcements show significantly negative associations for negative events and significantly positive associations for positive events. However, contemporaneous message board activity shows the opposite effect. Message volume and recommendations made during the event period are significant and positively related to excess return observed as a result of negative news events and negatively related to excess return observed as a result of positive news events. Our results suggest that the presence of message board discussions prior to positive news releases are likely to act in favour of the investors but the presence of discussions prior to negative news releases are likely to work against them.

Table 8-3: Regression for Excess Returns for Company Announcements

This table presents regression estimation outputs for excess returns associated with company announcement events. The dependent variable is the cumulative excess returns over a 2-day window [i.e. 0,+1]. 'Messages' is the cumulative number of messages posted over 5 days as at 't-1' with 't' being the event day. 'Sentiment' is the cumulative value of sentiments over 5 days as at 't-1'. 'Size' is the natural log of market value of equity as at the end of the month prior to when the announcement was made. 'B-M ratio' is the ratio of book value to market value of equity as at the end of the month prior to when the announcement was made. 'Past month return' is the previous month's stock return. 'Volatility' is the realised volatility, measured using daily data without Newey-West correction over the last 20 days relative to 't-1' (i.e. from t-20 to t-1).

Panel A: Negative News Events				
	(1)		(2)	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	0.013	5.09 ***	0.014	5.29 ***
Pre-event messages	-0.752	-14.87 ***		
Event messages	0.215	9.78 ***		
Pre-event recommendation			-0.392	-5.52 ***
Event recommendation			0.086	2.79 ***
Size	-0.098	-2.78 ***	-0.130	-3.62 ***
B-M Ratio	-0.001	-10.69 ***	-0.001	-10.65 ***
Past month return	-0.941	-3.11 ***	-0.992	-3.24 ***
Volatility	-7.607	-42.88 ***	-7.981	-45.12 ***
No. of Obervations	7947		7947	
Adjusted R-Squared	0.289		0.271	

Panel B: Positive News Events				
	(1)		(2)	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	0.001	0.31	0.004	1.35
Pre-event messages	1.365	30.99 ***		
Event messages	-0.527	-25.93 ***		
Pre-event recommendation			1.252	20.17 ***
Event recommendation			-0.537	-17.68 ***
Size	-0.033	-0.97	-0.050	-1.42
B-M Ratio	0.000	0.09	0.000	-0.98
Past month return	0.050	0.17	0.350	1.13
Volatility	7.992	46.97 ***	8.573	49.73 ***
No. of Obervations	9225		9225	
Adjusted R-Squared	0.351		0.314	

*,** and *** are statistically significant at 10%,5% and 1% respectively.

Regression of trading volume responses to company news events in the presence of message board activity are reported in Table 8-4. The dependent variable is the two-day [0,+1] abnormal trading volume at company announcement periods. The results show that trading volumes have a negative association with excess event returns in the case of negative news events and a positive association with excess returns in the case of positive news events. When there is a drop in share price as a result of information release, investors are likely to be reluctant to trade. In the case of positive announcements however, higher returns are likely to increase the trading volume.

Table 8-4: Trading Volume Regressions with Message Board Activity

The dependent variable is the two-day [0,+1] abnormal trading volume at company announcements. Abnormal trading volume is calculated as the difference between daily log volume (i.e. logarithm of 1 plus daily volume) and the average log volume on days -131 to -6. 'Pre-event Messages' and 'Pre-event Sentiment' are the cumulative numbers of messages posted and the value of sentiment index respectively over 5 days as at 't-1' with 't' being the event day. 'Event Messages' and 'Event Sentiment' are the cumulative numbers of messages posted and the value of sentiment index respectively over [0,+1] days. 'Size' is the natural log of market value of equity as at the end of the month prior to the announcement. 'B-M ratio' is the ratio of book value to market value of equity as at the end of the month prior to the announcement. 'Past month return' is the previous month's stock return. 'Volatility' is the realised volatility, measured using daily data without Newey-West correction over the last 20 days relative to 't-1' (i.e. from t-20 to t-1).

Panel A: Negative News Events

	(1)		(2)	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	2.585	23.68 ***	2.543	22.63 ***
Excess Return [0,+1]	-6.591	-14.32 ***	-7.637	-16.34 ***
Pre-event Messages	0.048	5.29 ***		
Event Messages	0.239	11.39 ***		
Pre-event recommendations			0.091	7.21 ***
Event recommendations			0.145	5.01 ***
Size	0.476	32.51 ***	0.503	33.52 ***
B-M Ratio	0.000	4.69 ***	0.000	4.35 ***
Past month return	1.266	10.22 ***	1.321	10.37 ***
Volatility	0.206	2.57 **	0.409	4.98 ***
No. of Obervations	7468		7468	
Adjusted R-Squared	0.272		0.230	

Panel B: Positive News Events

	(1)		(2)	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	2.975	27.12 ***	3.017	26.69 ***
Excess Return [0,+1]	9.606	21.73 ***	11.358	25.66 ***
Pre-event Messages	-0.009	-0.96		
Event Messages	0.359	18.13 ***		
Pre-event recommendations			0.041	3.16 ***
Event recommendations			0.221	8.32 ***
Size	0.415	28.32 ***	0.436	28.94 ***
B-M Ratio	0.000	2.58 ***	0.000	1.57
Past month return	1.556	12.23 ***	1.670	12.74 ***
Volatility	0.305	3.82 ***	0.492	6.00 ***
No. of Obervations	8710		8710	
Adjusted R-Squared	0.274		0.229	

*,** and *** are statistically significant at 10%,5% and 1% respectively.

8.5.3 Does Message Board Activity Contribute to Post-Announcement Drift in Stock Prices?

Post-earnings announcement drift has been the most studied and the longest-standing unresolved issue in the finance and accounting literature. Earlier studies have argued that individual investors' behaviour contributes to some extent to post-earning announcement drifts (see for example Bartov, Radhakrishnan & Krinsky (2000); Brown & Han (2000)). We examine how message board activity contributes to post-announcement drift by focusing our study on unscheduled releases of company news. Unlike the existing literature, we look at the post-announcement drift over a shorter term as the message board impact is expected to be short-lived. As such, in our study, post-announcement drift is measured by cumulative abnormal returns from *t+2* to *t+6*. Like event excess return, post-announcement drift is first studied in a univariate setting and then regressed against the message board variables and other firm characteristics considered to be important in causing drifts.

Table 8-5: Regression for Excess Post-announcement Returns

The dependent variable is the 5 day [+2,+6] cumulative excess returns. 'Pre-event Messages' and 'Pre-event Sentiment' are the cumulative number of messages posted and value of sentiment index respectively over 5 days as at 't-1' with 't' being the event day. 'Event Messages' and 'Event Sentiment' are the cumulative number of messages posted and value of sentiment index respectively over [0,+1] days. 'Post-event Messages' and 'Post-event Sentiment' are the cumulative number of messages posted and value of sentiment index respectively over [+2,+6] days. 'Size' is the natural log of market value of equity as at the end of the month prior to when the announcement was made. 'B-M ratio' is the ratio of book value to market value of equity as at the end of the month prior to when the announcement is made. 'Past month return' is the previous month's stock return. 'Volatility' is the realised volatility, measured

using daily data without Newey-West correction over the last 20 days relative to 't-1' (i.e. from t-20 to t-1).

Panel A: Negative News Events				
	(1)		(2)	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	0.006	1.29	0.000	-0.04
Event Return	-0.135	-6.63 ***	-0.113	-5.61 ***
Pre-event Messages	-0.357	-7.84 ***		
Event Messages	-0.453	-4.38 ***		
Post-event Messages	0.423	8.86 ***		
Pre-event Recommendation			-0.296	-5.30 ***
Event Recommendation			0.159	1.24
Post-event Recommendation			0.046	3.32 ***
Size	0.042	0.65	0.098	1.53
B-M Ratio	-0.002	-6.50 ***	-0.002	-6.44 ***
Past month return	0.945	1.73 *	0.799	1.45
Volatility	-0.787	-2.17 **	-0.411	-1.16
No. of Obervations	7947		7947	
Adjusted R-Squared	0.026		0.015	

Panel B: Positive News Events				
	(1)		(2)	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	-0.009	-1.97 **	-0.025	-5.57 ***
Event Return	-0.018	-1.02	-0.017	-0.96
Pre-event Messages	-0.723	-17.57 ***		
Event Messages	-0.620	-6.96 ***		
Post-event Messages	1.080	25.62 ***		
Pre-event Recommendation			-0.253	-4.72 ***
Event Recommendation			0.274	2.49 **
Post-event Recommendation			0.091	6.56 ***
Size	0.181	3.05 ***	0.369	6.09 ***
B-M Ratio	-0.001	-4.61 ***	-0.001	-4.95 ***
Past month return	1.601	3.09 ***	2.223	4.16 ***
Volatility	-0.898	-2.72 ***	0.585	1.75 *
No. of Obervations	9225		9225	
Adjusted R-Squared	0.081		0.018	

*,** and *** are statistically significant at 10%,5% and 1% respectively.

The univariate results are presented in Table 8-2 and multivariate estimates in Table 8-5. The univariate results suggest that highly discussed negative events experience a continuation of post-announcement negative drifts whereas the drift is not significant for other news categories. After controlling for other variables, pre-event message volume and messages posted during the announcement event periods are significant and negatively related to post-announcement drifts for both positive and negative announcement types. Post-event message volume, however, is positively related to announcement drifts. Similarly post-event recommendations also have a significant and positive relationship to post-drifts. These results suggest that, irrespective of news type, contemporaneous message board activity contributes to positive return drifts.

8.5.4 Does Message Board Affect Stocks' Informational Environment?

We use volatility and liquidity measures as proxies for stocks' informational environments. Table 8-6 reports the variance of excess stock returns on days -1 through to +3 relative to the release of company news. For each news type, t-statistics are provided to determine whether the average ratio of the variance measure on that date to the average measure during the estimation period (i.e. days -131 to -6) is different from one. In cases of negative news, the ratio was greater than one for all days around the news release and this suggests that volatility around the time of negative news releases is significantly higher than the historical average volatility. In cases of neutral news, the volatility was significantly lower on days 0 and 1 only. For positive news events, volatility was significantly higher on all days around news releases for events with prior messages only. In general, the mean volatility ratios on most days were greater for events with high levels of messages than that with low levels. This result indicates that

the level of message board activity is likely to increase valuation uncertainty and hence, increase volatility in share prices as a result of unscheduled new release.

Table 8-6: Variance of Stock Returns on Days around Company News

The table reports the variances of excess stock returns on days -1 through to +3 relative to the company news. Under the null hypothesis, the ratios of variance on the days around the company news will be equal to its long term historical average. For each sub-category, t-statistics are provided for the test which determines whether the average ratio of the variance measure on that date to the average measure during the estimation period (days -131 to -6) is different from one.

	Day Relative to Company News									
	-1		0		1		2		3	
	mean	t-stats	mean	t-stats	mean	t-stats	mean	t-stats	mean	t-stats
Negative News										
Without Messages	1.34	3.5 ***	1.50	4.8 ***	1.68	4.6 ***	1.29	2.3 **	1.24	2.8 ***
With Messages	1.72	4.3 ***	2.11	6.5 ***	1.72	4.5 ***	1.46	5.5 ***	1.58	3.2 ***
- High Messages	2.21	2.6 **	2.59	3.9 ***	1.83	2.3 **	1.36	3.8 ***	1.43	4.0 ***
- Low Messages	1.24	3.5 ***	1.60	4.2 ***	1.58	4.3 ***	1.54	2.6 ***	1.52	2.2 **
Neutral News										
Without Messages	0.96	-0.5	0.43	-15.8 ***	0.44	-15.1 ***	1.02	0.1	0.95	-0.5
With Messages	1.10	1.3	0.55	-14.6 ***	0.55	-15.3 ***	1.02	0.2	1.03	0.3
- High Messages	1.13	1.2	0.53	-10.8 ***	0.52	-10.9 ***	0.83	-2.0 *	1.16	0.9
- Low Messages	1.03	0.1	0.57	-7.6 ***	0.56	-8.1 ***	1.13	1.0	0.92	-0.8
Positive News										
Without Messages	1.06	1.2	14.19	1.1	5.42	1.2	1.51	3.7 ***	2.88	1.3
With Messages	1.52	6.1 ***	3.70	13.0 ***	1.69	11.6 ***	1.49	4.4 ***	1.22	4.6 ***
- High Messages	1.89	4.6 ***	5.37	7.7 ***	1.73	8.1 ***	1.49	6.1 ***	1.24	3.9 ***
- Low Messages	1.19	3.2 ***	2.40	12.7 ***	1.70	5.9 ***	1.47	2.3 **	1.21	1.8 *

*,** and *** are statistically significant at 10%,5% and 1% respectively.

Table 8-7: Illiquidity of Stock Returns on Days around Company News

The table reports the Amihud illiquidity measures of excess stock returns on days -1 through to +3 relative to the company news. Under the null hypothesis, the ratios of Amihud illiquidity measure on the days around the company news will be equal to its long term historical average. For each sub-category, t-statistics are provided for the test which determines whether the average ratio of the Amihud illiquidity measure on that date to the average measure during the estimation period (days -131 to -6) is different from one.

	Day Relative to Company News									
	-1		0		1		2		3	
	mean	t-stats	mean	t-stats	mean	t-stats	mean	t-stats	mean	t-stats
Negative News										
Without Messages	1.79	1.9 *	1.35	3.0 ***	1.55	2.2 **	1.46	2.5 **	1.48	2.9 ***
With Messages	1.14	3.2 ***	1.06	1.3	1.27	2.9 ***	1.32	3.2 ***	1.45	5.4 ***
- High Messages	1.06	1.3	0.93	-1.9 *	1.16	3.5 ***	1.13	2.9 ***	1.18	3.1 ***
- Low Messages	1.27	3.1 ***	1.11	2.0 **	1.60	1.8 *	1.38	2.7 ***	1.93	3.6 ***
Neutral News										
Without Messages	1.33	1.8 *	0.84	-1.4	0.77	-4.1 ***	1.21	1.2	1.14	0.7
With Messages	1.01	0.1	0.84	-2.3 **	1.72	1.2	1.22	1.5	1.02	0.5
- High Messages	1.02	0.3	0.95	-0.3	0.98	-0.2	1.16	1.1	1.05	0.5
- Low Messages	0.95	-0.8	0.86	-1.4	3.34	1.2	1.49	1.2	0.93	-1.0
Positive News										
Without Messages	1.21	2.6 **	1.08	1.5	1.12	1.6	1.39	2.9 ***	1.50	1.4
With Messages	1.28	2.2 **	0.90	-3.0 ***	0.94	-1.7 *	1.14	1.6	1.09	1.1
- High Messages	1.16	1.0	0.86	-4.3 ***	0.93	-1.1	0.96	-0.7	1.03	0.5
- Low Messages	1.59	1.7 *	1.06	0.6	0.99	-0.1	1.48	1.7 *	0.95	-1.0

*,** and *** are statistically significant at 10%,5% and 1% respectively.

Table 8-7 reports the illiquidity of stock returns on days around company news releases. For each sub-category, t-statistics are provided for the test which determines whether the average ratio of illiquidity measure on that date relative to its historical average is different from one. There is no obvious pattern of illiquidity change in cases of neutral and positive news events suggesting that such events do not cause any change in liquidity. Negative news, however, is followed by illiquidity ratios that are greater than one, suggesting that liquidity tends to decrease following news releases. The liquidity is likely to decrease following the news release if the events have small

volumes of prior message board activity. This can be seen at the level of message posting activity, where the illiquidity ratio after the arrival of news is generally lower for 'High Messages' than that for 'Low Messages'.

8.6 Conclusion

In this chapter, we examined message board activity on days around price-sensitive unscheduled company news. Our study was related to stock message boards and market reactions to corporate news, and to the contribution of message board activity to post-announcement drifts. This chapter also examined how message board activity affects aspects of firms' informational environments such as volatility and liquidity in share prices.

We used the dates of unscheduled company news releases as the event days and examined message board activity around these days. We performed univariate comparison and multivariate regressions with variables representing message board and firm characteristics. We then proceeded to investigate the impact of message board activity on firms' informational environments. The impacts of news events on volatility and liquidity in the presence of message board discussions were also examined.

We found evidence to suggest that both the message volume and recommendation levels are elevated prior to unscheduled announcements, which suggests that message board participants could be expecting news. They may be aware of impending news arrivals and increased message volume may be indicating speculation about their contents.

After controlling for firm size, growth and share price characteristics, we found that the message board variables prior to announcements showed significantly negative associations with returns for negative news events and significantly positive

associations with returns for positive news events. Abnormal trading volume had a positive association with message board variables for both positive and negative news. Similarly, post-event message volume and post-event sentiment were positively related to announcement drifts. Irrespective of news type, we found that contemporaneous message board activity causes positive return drifts, which suggests that the higher the message board activity, the higher the likelihood of return drift. In cases of negative news, volatility around event days is significantly higher than its historical average, whereas for neutral news, the volatility is significantly less on days 0 and 1 only. In cases of positive news, volatility is significantly increased on all days around news releases for events with prior messages only. From our study on liquidity, positive and neutral news events do not seem to bring any change in liquidity. Negative news, however, is followed by illiquidity ratios that are greater than one, suggesting that liquidity tends to decrease following news releases. The overall finding is that the level of message board discussion prior to news release works in favour to investors for positive news and acts against them in cases of negative news.

Chapter IX: Conclusion

With the growing popularity of message boards in their role of disseminating information, academic researchers have shown an increasing interest in recent times in. The existing body of literature on message boards largely based on US data is still divided about whether message boards predict or follow the stock market. While researchers have begun using sophisticated ways of extracting sentiments from message board posts and building complex models to better represent those sentiments, the answers to basic questions such as why people post messages and how these postings affect share trading variables other than stock returns (for example, trading volume and volatility) remain unclear.

We examined the relationships of stock message boards with share trading variables such as stock returns, trading volume, volatility and liquidity in stock prices around the days with abnormal levels of message posting activity. We used recommendation level and changes in recommendation as proxies for the opinions of message board participants. We constructed five different empirical studies to examine the relationship of message board to stock returns, trading volume, volatility and liquidity

We studied over 1.7 million messages posted by more than 10,000 unique posters on 764 of the largest firms (based on market capitalisation) listed on the Australian Stock Exchange as of 17 July 2009. The study period was for five years starting from 1 January 2004 through to the end of 2008. We started with the largest 1000 firms on the ASX and after excluding the companies which had one or more observations missing, we ended up with our final sample size of 764 firms. We used DataStream and SIRCA for share price related data and news data respectively.

Chapters 4, 5 and 6 analysed the impact of message boards on trading variables and Chapters 7 and 8 studied the behaviour of message board participants.

In Chapter 4, we studied the relationship between stock returns and message board activity under two different conditions: normal message board activity and abnormal message board activity. We found evidence to suggest that there exists a two-way relationship between message board and stock market returns, but only in the very short-run (up to two trading days). That is, we found that message boards can Granger-cause stock returns and vice versa. Instead of arguing about whether message boards predict or reflect stock markets, we found two-way relationships. Our portfolio analysis did not reveal any significant return difference between stocks with high and low message board activity. The examination of returns around the days with abnormally high message board postings showed that message board variables appeared to be negatively related to the next day's return but these variables provided no predictive power over returns thereafter. We observed that investors were likely to discuss stocks on message boards toward the end of share price momentum cycles and as such, careful consideration is warranted from investors before acting on these recommendations.

In Chapter 5, we examined volatility changes that occur as a result of abnormal message board activity by using three different measure of volatility: probability of post-event volatility being higher than pre-event volatility, standard deviation of stock returns and expected value of squared returns. We found evidence to suggest that volatility increases after periods of abnormal message board activity. This could be due to the fact that abnormal levels of message board activity bring a lot of information within a short time period and as a result, unsophisticated investors are likely to be stimulated to trade due to the wave of interest caused by the abnormal message board activity. We also found that the number of unique user participations and volatility

changes are positively related to each other. In order to test the robustness of our results, we re-analysed our sample by dividing it into two categories: those with news and without news – but the results remained valid for all sub-sets.

In Chapter 6, we examined trading volume and liquidity changes around high-message posting event days. Our results showed that trading volume was likely to increase following abnormal message posting activity. Message board volume was positively related to trading volume whereas the higher the recommendation level, the lower the trading volume likely to be. Recommendation change was negatively related to trading volume prior to abnormal message posting events but showed a positive association after the events. Our examination of the control variables used in the study suggests that increases in trading volume brought about by abnormal message posting activities are more pronounced for small firms, growth firms and the firms with greater share price momentum than other firms. A similar examination of liquidity proxies suggested that while message boards appear to have some effect on liquidity improvement, this improvement is fully explained by firm characteristics and momentum variables. Small firms, growth firms and the firms with high momentum in share prices are likely to have their share price liquidity increased after high levels of message board activity.

In Chapter 7, we studied the determinants of message board activity and the influence of message board recommendations on future stock returns by using monthly data. Our results suggest that investors are likely to favour growth firms, larger firms and firms with share price momentum. After controlling for potential biases in message board recommendations, we did not find that message board recommendations added any economic usefulness to investment decisions. Consensus recommendation changes,

however, had a significantly negative relationship with future returns. The division of our sample into two different sub-periods, market upturn and downturn, revealed that recommendations seem to be highly correlated with future performance during market upturns and the negative correllation with changes seems to be stronger in down markets.

In Chapter 8, we investigated message board activity on days around price-sensitive company news. We considered unscheduled company news release dates as the event days and examined message board activity around these event days. We found evidence to suggest that both message volume and recommendation values were elevated prior to unscheduled announcements. After controlling for firm size, growth and share price characteristics, we noted a significantly negative association between message board variables and stock returns for negative news events and a significantly positive association between message board variables and stock returns for positive news events. Abnormal trading volume had a positive association with message board variables for all news types. Our results also suggest that, irrespective of news type, contemporaneous message board activity causes positive return drifts. In cases of negative news, volatility around event days was significantly higher than the historical average volatility whereas for neutral news, the volatility was significantly less on event days and the following day only. In cases of positive news, volatility was significantly increased on all days around the news release for events with prior messages only. In cases of liquidity changes, positive and neutral news events did not seem to bring any changes in liquidity. Negative news, however, was followed by illiquidity ratios that were greater than one, suggesting that liquidity tends to decrease following news releases.

Thus, our overall finding is that message boards are not likely to have much influence on share prices and liquidity. However, abnormally high levels of message board discussion are likely to increase trading volume and the volatility of share prices. With the increase in volatility they cause, message boards can be considered to be adding a layer of risk to investors.

Message board participants exhibit some bias towards growth firms, larger firms and firms with share price momentum. After controlling for these biases, we did not find much investment value in message board recommendations. Around days with unscheduled company news releases, elevated levels of message board discussion were observed. Reactions to these news events were affected by the levels of message board discussion prior to the events. We also noted that the level of message board discussion prior to the news event was positively related to investors' share price reactions to the news.

9.1 Direction for Future Work

We have presented empirical tests to explore the intriguing question of the influence of message boards on stock returns. Our study used a unique dataset on Australian stock message boards. The data we obtained from *HotCopper* contained several features that were useful for academic study. We see a potential to expand our work further in the following directions.

First, the dataset uniquely identifies each poster. We can track when an investor posts a message and when the posts are revised. This tracking ability can allow us to study the behavioural side of social interactions. For example, we can study *homophily*, the tendency to associate with like-minded people, among investors. Second, sophisticated methods are being developed to extract sentiments from message board

texts. We did need to use text-mining techniques to extract investors' sentiment as our dataset has voluntarily disclosed sentiments with each post. However, it would be interesting to compare extracted sentiments to stated sentiments. There is a possibility of using computational linguistic techniques on our text data to perform this analysis.

Bibliography

Admanti, A.R. & Pfleiderer, P. 1988, 'A Theory of Intraday Patterns: Volume and Price Variability', *Review of Financial Studies*, vol. 1, pp. 3-40.

Amihud, Y. 2002, 'Illiquidity and stock returns: cross-section and time-series effects', *Journal of Financial Markets*, vol. 5, no. 1, pp. 31-56.

Amihud, Y. & Mendelson, H. 1989, 'The Effects of Beta, Bid-Ask Spread, Residual Risk and Size on Stock Returns', *Journal of Finance*, vol. 44, pp. 479-486.

Anders, J. 1999, 'Yahoo! puts label on stock chat site: it's entertainment - Warning stands in contrast to how many investors use the online services', *Wall Street Journal (Eastern Edition)*, p. 1.

Antweiler, W. & Frank, M. 2004, 'Is all that talk just noise? The information content of internet stock message boards', *The Journal of Finance*, vol. 59, no. 3, pp. 1259-1294.

Armstrong, D. 2004, 'A rtiree in Texas gives a firm grief with web posting', *Wall Street Journal* p. 1.

Asthana, S., Balsam, S. & Sankaraguruswamy, S. 2004, 'Differential response of small versus large investors to 10-K filings on EDGAR', *Accounting Review*, vol. 79, no. 3, pp. 571-589.

Azzi, S. & Bird, R. 2005, 'Prophets During Boom and Gloom Downunder', *Global Finance Journal*, vol. 15, pp. 337-367.

Bagnoli, M., Beneish, M. & Watts, S. 1999, 'Whisper Forecasts of Quarterly Earning Per Share', *Journal of Accounting and Economics*, vol. 28, pp. 27-50.

Baker, M. & Stein, J.C. 2004, 'Market Liquidity as a Sentiment Indicator', *Journal of Financial Markets*, vol. 7, pp. 271-299.

Baker, M. & Wurgler, J. 2006, 'Investor Sentiment and the Cross Section of Stock Returns', *The Journal of Finance*, vol. 61, no. 4, pp. 1645-1680.

Barber, B., Odean, T. & Zhu, N. 2009, 'Do retail trades move markets?', *Review of Financial Studies*, vol. 22, no. 1, p. 151.

Barberris, N., Shleifer, A. & Vishny, R. 1998, 'A Model of Investor Sentiment', *Journal of Financial Economics*, vol. 49, pp. 307-343.

Bartov, E., Radhakrishnan, S. & Krinsky, I. 2000, 'Investor Sophistication and Patterns in Stock Returns after Earnings Announcements', *Accounting Review*, vol. 75, no. 1, pp. 43-63.

Bettman, J., Hallett, A. & Sault, S. 2007, 'The Impact of Electronic Message Board Takeover Rumors on the US Equity Market', Working Paper, Australian National University.

Bhagat, S., Brickley, J. & Loewenstein, U. 1987, 'The Pricing Effect of Interfirm Cash Tender Offers', *The Journal of Finance*, vol. 42, pp. 965-986.

Bhattacharya, N. 2001, 'Investors' Trade Size and Trading Responses Around Earning Announcements: An Empirical Investigation', *Accounting Review*, vol. 76, no. 2, pp. 221-244.

Bird, R., Grosse, M. & Yeung, D. 2010, 'The Market Response to Exploration, Resource and Reserve Announcements by Mining Companies: Australian Data', Working Paper Series 7, The Paul Woolley Centre, University of Technology Sydney.

Bird, R. & Yeung, D. 2010, 'How Do Investors React Under Uncertainty?', Working Paper Series 8, The Paul Woolley Centre, University of Technology Sydney.

Bischof, D. 2001, 'Through Accusations of Defamation, Companies are Starting to Unmask Anonymous Online Critics', *New Media and The Law*, vol. 25, no. 1, pp. 35-36.

Blume, L., D., E. & O'Hara, M. 1994, 'Market Statistics and Technical Analysis: The Role of Volume', *Journal of Finance*, vol. 49, pp. 153-182.

Brennan, M.J., Chordia, T. & Subrahmanyam, A. 1998, 'Alternative Factor Specifications, Security Characteristics, and the Cross-section of Expected Stock Returns', *Journal of Financial Economics*, vol. 49, pp. 345-373.

Brennan, M.J. & Subrahmanyam, A. 1996, 'Market Microstructure and Asset Pricing: On the Compensation for Illiquidity in Stock Returns', *Journal of Financial Economics*, vol. 41, pp. 441-464.

Brown, G.W. 1999, 'Volatility, sentiment, and noise traders', *Financial Analysts Journal*, vol. 55, no. 2, pp. 82-90.

Brown, L. & Han, J. 2000, 'Do Stock Prices Fully Reflect the Implications of Current Earnings for Future Earnings for AR1 Firms?', *Journal of Accountin Research*, vol. 38, no. 1, pp. 149-164.

Brown, S. & Warner, J. 1985, 'Using Daily Stock Returns: The Case of Event Studies', *Journal of Financial Economics*, vol. 14, pp. 3-31.

Buckman, R. 1999, 'Web Postings Draw Charges of Stock Fraud', *Wall Street Journal*, no. December 16, p. C1.

Buraschi, A. & Jilstov, A. 2003, 'Option Volume and Differences in Beliefs', LBS Working Paper.

Campbell, C. & Wasley, C. 1996, 'Measuring Abnormal Daily Trading Volume for Samples of NYSE/ASE and NASDAQ Securities using Parametric and Non-

parametric Test Statistics', *Review of Quantitative Finance and Accounting*, vol. 6, no. 3, pp. 309-326.

Campbell, J., Lo, A. & MacKinlay, C. 1997, *The Econometrics of Financial Markets*, Princton University Press, Princeton, NJ.

Campbell, J.Y., Grossman, S.J. & Wang, J. 1993, 'Trading Volume and Serial Correlation in Stock Returns', *Quarterly Journal of Economics*, vol. 108, pp. 905-939.

Campbell, J.Y., Lettau, M., Malkiel, B. & Xu, Y. 2001, 'Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk', *The Journal of Finance*, vol. 56, no. 1, pp. 1-43.

Cao, H.H., Joshua, D.C. & Hirshleifer, D. 2002, 'Sidelined Investors, Trade-generated News, and Security Returns', *Review of Financial Studies*, vol. 15, pp. 615-648.

Carson, J. & Felton, J. 2004, 'New Technology Issues for Corporate Governance: Internet Message Boards', in C.F. Joseph & Lufkin (eds), *International Corporate Governance*, 2 edn, Euromoney Books, pp. 184-194.

Choe, H., Kho, B.-C. & Stulz, R.M. 1999, 'Do foreign investors destabilize stock markets? The Korean experience in 1997', *Journal of Financial Economics*, vol. 54, no. 2, pp. 227-264.

Chordia, T. & Swaminathan, B. 2000, 'Trading Volume and Cross-Autocorrelations in Stock Returns', *Journal of Finance*, vol. 55, no. 2, pp. 913-935.

Clarkson, P., Joyceb, D. & Tutticci, I. 2006, 'Market reaction to takeover rumour in Internet Discussion Sites', *Accounting and Finance*, vol. 46, no. 1, pp. 31-52.

Clarksona, P., Joyceb, D. & Tutticci, I. 2006, 'Market reaction to takeover rumour in Internet Discussion Sites', *Accounting and Finance*, vol. 46, no. 1, pp. 31-52.

Clayton, M.C., Hartzell, J.C. & Rosenberg, J. 2005, 'The Impact of CEO Turnover on Equity Volatility', *Journal of Business*, vol. 78, no. 5, pp. 1779-1808.

Daniel, K., Hirshleifer, D. & Subrahmanyam, A. 1998, 'Investor Psychology and Security Market Under and Overreactions', *Journal of Finace*, vol. 53, no. 1839-1886.

Danthine, J.P. & Moresi, S. 1993, 'Volatility, information and noise trading', *European Economic Review*, vol. 37, no. 5, pp. 961-983.

Das, S., Martínez Jerez, A. & Tufano, P. 2005, 'eInformation: A clinical study of investor discussion and sentiment', *Financial Management*, vol. 34, no. 3, pp. 103-137.

David, A. 2003, 'Heterogeneous Belifs, Trading Risk, and the Equity Premium', Washington University Working Paper.

DeLong, Bradford, J., Shleifer, A., Summers, L., H. Summers & Waldmann, R., J. Waldmann 1990, 'Noise Trader Risk in Financial Markets', *Journal of Political Economy*, vol. 98, no. 4, pp. 703-738.

DeLong, Bradford, J., Shleifer, A., Summers, L. & Waldmann, R.J. 1991, 'The Survival of Noise Traders in Financial Market', *Journal of Business*, vol. 64, pp. 1-20.

Delort, J., Arunasalam, B., Milosavljevic, M. & Leung, H. 2009, 'The Impact of Manipulation in Internet Stock Message Boards', unpublished, CMCRC.

DeMarzo, P., Vayanos, D. & Zwiebel, J. 2003, 'Persuasion Bias, Social Influence and Unidimensional Opinions', *Quarterly Journal of Economics*, vol. 118, no. 3, pp. 909-968.

Dhar, R. & Zhu, N. 2006, 'Upclose and Personal: An Individual Level Analysis of the Disposition Effect', *Management Science*, vol. 52, no. 5, pp. 726-740.

DiFonzo, N. & Bordia, P. 1997, 'Rumor and prediction: Making sense (but losing dollars) in the stock market', *Organizational Behavior and Human Decision Processes*, vol. 71, no. 3, pp. 329-353.

Dow, J. 2002, 'Self-sustaining Liquidity in an Asset Market with Asymmetric Information', London Business School Working Paper.

Ewing, J. 2000, 'Is the Weak Euro Making Germany Complacent?', *Business Week*, no. May 15.

Fama, E.F. 1970, 'Efficient Capital Markets: A Review of Theory and Empirical Work', *Journal of Finance*, vol. 25, no. 2, pp. 383-417.

Feng, L. & Seasholes, M. 2005, 'Do Investors Sophistication and Trading Experience Eliminate Behavioral Biases in Financial Markets?', *Review of Finance*, vol. 9, no. 3, pp. 305-351.

Frazzini, A. 2006, 'The Disposition Effect and Underreaction to News', *The Journal of Finance*, vol. 61, no. 4, pp. 2017-2046.

Gallant, A.R., Rossi, P.E. & Tauchen, G. 1993, 'Stock Prices and Volume', *Review of Financial Studies*, vol. 5, pp. 199-242.

Glaser, M., Webber, M. & Langer, T. 2010, 'Overconfidence of Professionals and Lay People: Individual Differences within and between Tasks', *SSRN eLibrary*.

Granger, C.W.J. 1969, 'Investigating Casual Relations By Econometric Models and Cross Spectral Methods', *Econometrica*, vol. 36, pp. 424-438.

Grinblatt, M. & Keloharju, M. 2001, 'What Makes Investors Trade?', *Journal of Finace*, vol. 56, no. 2, pp. 589-616.

Gu, B., Konana, P. & Chen, H. 2008, 'Melting-pot or Homophily? An Empirical Investigation of User Interactions in Virtual Investment-Related Communities', *SSRN eLibrary*.

Harris, M. & Artur, R. 1993, 'Differences of Opinion Make a Horse Race', *Review of Financial Studies*, vol. 6, pp. 473-506.

Harrison, J.M. & Kreps, D.M. 1978, 'Speculative Investor Behavior in a Stock Market with Heteregeneous Expectations', *Quarterly Journal of Economics*, vol. 92, pp. 323-336.

Hasbrouck, J. 2006, 'Trading Costs and Returns for US Equities: Estimating Effective Daily Costs using Daily Data', New York University Working Paper.

He, H. & Wang, J. 1995, 'Differential Information and Dynamic Behaviour of Stock Trading Volume', *Review of Financial Studies*, vol. 8, pp. 919-972.

Hegde, S.P. & McDermott, J.B. 2003, 'The liquidity effects of revisions to the S&P 500 index: an empirical analysis* 1', *Journal of Financial Markets*, vol. 6, no. 3, pp. 413-459.

Hirschey, M., Richardson, V. & Scholz, S. 2000, 'How "Foolish" are Internet Investors?', *Financial Analysts Journal*, vol. 56, pp. 62-69.

Hirshleifer, J. 1977, 'The Theory of Speculation under Alternative Regimes of Markets', *Journal of Finance*, vol. 32, pp. 975-999.

Hof, R.D. & Saveri, G. 1999, 'Inside and Internet IPO', *Business Week*, no. September 6.

Hong, H., Kubik, J.D. & Stein, J.C. 2004, 'Social interaction and stock-market participation', *The Journal of Finance*, vol. 59, no. 1, pp. 137-163.

Hong, H. & Stein, J. 1999, 'A Unified Theory of Underreaction, Momentum Trading and Overreactions in Asset Markets', *Journal of Finance*, vol. 54, pp. 2143-2184.

Hong, H. & Stein, J.C. 2003, 'Differences of Opinion, Short-sales Constraints, and Market Crashes', *Review of Financial Studies*, vol. 16, pp. 487-525.

HotCopper 2010, viewed 20 August 2010 <http://www.hotcopper.com.au/>.

HotCopper 2011, viewed 20 August 2010 <http://www.hotcopper.com.au/>.

Hvistendahl, E.V. & Chen, X. 2009, 'Automatic Data Extraction from Online Discussion Boards', University of Agder, Grimstad.

Jagadeesh, N. & Titman, S. 2002, 'Cross-Sectional and Time-Series Determinants of Momentum Returns', *Review of Financial Studies*, vol. 15, no. 1, pp. 143-157.

Jayaraman, N. & Shastri, K. 1993, 'The Effects of the Announcements of Dividend Increase on Stock Return Volatility: The Evidence from the Options Market', *Journal of Business Finance & Accounting*, vol. 20, no. 5, pp. 673-685.

Jones, A.L. 2006, 'Have Internet Message Boards Changed Market Behavious', *info*, vol. 8, no. 5, pp. 67-76.

Kalay, A. & Loewenstein, U. 1985, 'Predictable Events and Excess Returns: The Case of Dividend Announcements', *Journal of Financial Economics*, vol. 14, pp. 423-449.

Kaniel, R., Saar, G. & Titman, S. 2004, 'Individual Investor Sentiment and Stock Returns', *SSRN eLibrary*.

Karpoff, J.M. 1988, 'Costly Short Sales and the Correlation of Returns with Volume', *Journal of Financial Research*, vol. 51, pp. 173-188.

Kliger, D. & Sarig, O. 2000, 'The Information Value of Bond Ratings', *The Journal of Finance*, vol. 55, no. 6, pp. 2879-2902.

Koski, J., Rice, E. & Tarhouni, A. 2007, 'Noise trading and volatility: Evidence from day trading and message boards', Working Paper.

Koski, J.L., Rice, E.M. & Tarhouni, A. 2004, 'Noise Trading and Volatility: Evidence from Day Trading and Message Boards', *SSRN eLibrary*.

Kothare, M. 1997, 'The effects of equity issues on ownership structure and stock liquidity: A comparison of rights and public offerings', *Journal of Financial Economics*, vol. 43, no. 1, pp. 131-148.

Kumar, A. 2009, 'Hard-to-value Stocks, Behavioral Biases, and Informed Trading', *Journal of Financial and Quantitative Analysis*, vol. 44, no. 6, pp. 1375-1401.

Kumar, A. & Lee, C.M.C. 2006, 'Retail Investor Sentiment and Return Comovements', *The Journal of Finance*, vol. 61, no. 5, pp. 2451-2486.

Kyle, A.S. 1985, 'Continuous Auctions and Insider Trading', *Econometrica*, vol. 53, pp. 1315-1335.

Lee, C. 1992a, 'Earning News and Small Traders: An Intraday Analysis', *Journal of Accounting and Economics*, vol. 15, no. 2-3, pp. 265-302.

Lee, C. 1992b, 'Earnings news and small traders: An intraday analysis', *Journal of Accounting and Economics*, vol. 15, no. 2-3, pp. 265-302.

Lerman, A. 2010, 'Individual Investors' Attention to Accounting Information: Message Board Discussions', unpublished, New York University.

Lev, B. 1989, 'On the Usefulness of Earnings and Earnings Research: Lessons and Directions from Two Decades of Empirical Research', *Journal of Accounting Research*, vol. 27, pp. 153-192.

Levitt, S.D. & Dubner, S.J. 2005, *Freakonomics: A rogoue Economist Explores the Hidden Side of Everything*, HarperCollins Publishers, New York, NY.

Livnat, J. & Petrovits, C. 2009, 'Investor Sentiment, Post-Earnings Announcement Drift, and Accruals', *SSRN eLibrary*.

Merton, R. 1987, 'Presidential Address: A Simple Model of Capital Market Equillibrium with Incomplete Information', *Journal of Finance*, vol. 42, pp. 483-510.

Odean, T. 1998, 'Are Investors Reluctant to Realize Losses?', *Journal of Finace*, vol. 53, no. 5, pp. 1775-1798.

Ohlson, J.A. & Penman, S.H. 1985, 'Volatility increases subsequent to stock splits: An empirical aberration', *Journal of Financial Economics*, vol. 14, no. 2, pp. 251-266.

Pagano, M. 1989a, 'Trading Volume and Asset Liquidity', *Quarterly Journal of Economics*, vol. 104, no. 2, pp. 255-274.

Pagano, M. 1989b, 'Endogenous Market Thinness and Stock Price Volatility', *Review of Economic Studies*, vol. 56, no. 2, pp. 269-287.

Park, J., Konana, P., Gu, B., Kumar, A. & Raghunathan, R. 2010, 'Confirmation Bias, Overconfidence and Investment Performance: Evidence from Stock Message Boards', *SSRN eLibrary*.

Pleis, L. 2007, 'Investment decisions: Influence of an Internet stock message board', University of North Texas.

Qu, S., Starks, L. & Yan, H. 2003, 'Risk, Dispersion of Analyst Forecasts and Stock Returns', UT Austin Working Paper.

Regnier, P. 1999, 'Why Fund Managers Lurk on the Boards?', *Money*, vol. 28, no. 6, pp. 169-171.

Roberts, G. 2011, *Anonymous Hotcopper Commenter Shuts Down Trading in Voyager Resources*, The Sunday Times, 2011.

Rosenberg, J.V., Clayton, M.J. & Hartzell, J.C. 2003, 'The Impact of CEO Turnover on Equity Volatility', *SSRN eLibrary*.

Sabherwal, S., Sarkar, S. & Zhang, Y. 2008, 'Online talk: does it matter?', *Managerial Finance*, vol. 34, no. 6, pp. 423-436.

Sankaraguruswamy, S. & Mian, G.M. 2008, 'Investor Sentiment and Stock Market Response to Corporate News', *SSRN eLibrary*.

Scharfstein, D.S. & Stein, J.C. 1990, 'Herd Behavior and Investment', *The American Economic Review*, vol. 80, no. 3, pp. 465-479.

Scheinkman, J. & Xiong, W. 2003, 'Overconfidence and Speculative Bubbles', *Journal of Political Economy*, vol. 111, no. 6, pp. 1183-1219.

Sherfin, H. & Statman, M. 1985, 'The Disposition to Sell Winners Too Early and Ride Losers Too Long: Theory and Evidence', *Journal of Finance*, vol. 40, no. 3.

Shleifer, A. & Summers, L. 1990, 'The Noise Trader Approach to Finance', *Journal of Economic Perspectives*, vol. 4, pp. 19-33.

Shleifer, A. & Vishny, R. 1997, 'The Limits of Arbitrage', *Journal of Finance*, vol. 52, pp. 35-55.

Singh, A.K., Zaman, M.A. & Krishnamurti, C. 1994, 'Liquidity Changes Associated with Open Market Repurchases', *Financial Management*, vol. 23, no. 1, pp. 47-55.

Stafford, P. 2010, *Mining Company Sues Hot Copper Online Investment Forum for Defamation*, Smartcompany.com.au, 2010.

Suominen, M. 2001, 'Trading Volume and Information Revealation in Stock Markets', *Journal of Financial and Quantitative Analysis*, vol. 36, pp. 545-565.

Tetlock, P.C. 2007, 'Giving Content to Investor Sentiment: The Role of Media in the Stock Market', *The Journal of Finance*, vol. 62, no. 3, pp. 1139-1168.

Tumarkin, R. & Whitelaw, R.F. 2001, 'News or noise? Internet postings and stock prices', *Financial Analysts Journal*, vol. 57, no. 3, pp. 41-51.

Weiss, G. 2000, 'Where Everyone is an Expert', *Business Week*, no. May 22, pp. 173-174.

West, K.D. 1988, 'Dividend Innovations and Stock Price Volatility', *Econometrica*, vol. 56, no. 1, pp. 37-61.

Wysocki, P.D. 1999, 'Cheap Talk on the Web: The Determinants of Postings on Stock Message Boards', Working Paper, University of Michigan.

Zhang, Y. & Swanson, P. 2010, 'Are day traders bias free?-evidence from internet stock message boards ', *Journal of Economics and Finance*, vol. 34, no. 1, pp. 96-112.