INVESTOR OVERCONFIDENCE AND OPTION TRADING

by

HAN-SHENG CHEN

Presented to the Faculty of the Graduate School of

The University of Texas at Arlington in Partial Fulfillment

of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

THE UNIVERSITY OF TEXAS AT ARLINGTON

May 2013

Acknowledgements

I would like to thank all my dissertation committee members for their guidance through the years I have worked on this study. My special “thank you” must be given to Dr. Sabherwal, the dissertation supervisor, who leads me step by step in each phase of works. He is just like a pilot guiding me through when I was lost. I am really grateful to him for his efforts being put on this dissertation.

I also would like to acknowledge the supports from my family. Peiyi, my dearest, is and will always be the main reason for me to move forward. Ever since we got married and came to the United States, her dedication to this family has allowed me to focus on my study and work. We will always remember the days during the years in the program; especially how we helped each other walk through tough times. My parents have been really supportive, even though they are on the other side of the earth. Moreover, I am always motivated and encouraged when I see my little ones, Roger and Mina.

Last but not least, all the supports and encouragements from my peers, friends, and staff in the Department of Finance and Real Estate and in the College of Business Administration are greatly appreciated. I am truly blessed to be surrounded by you all so that I may complete my doctoral studies in an intense but friendly atmosphere.

April 18, 2013

Abstract

INVESTOR OVERCONFIDENCE AND OPTIONS TRADING

Han-Sheng Chen, PhD

The University of Texas at Arlington, 2013

Supervising Professor: Sanjiv Sabherwal

This study examines investor overconfidence theory in the options market. The theory suggests that investors who experience high returns become overconfident in their security valuation and trading skills, and therefore trade more often, even when the high returns are market wide. Given stock investors often trade in both stock and options market, I hypothesize similar patterns could be found in the options market as well. Controlling for market volatility and stock idiosyncratic risk, past market return is positively correlated with option trading turnover. In addition, past positive market return leads to higher call option turnover ratio and higher call-to-put ratio. These findings are consistent with the overconfidence hypothesis.

In the second chapter, I further discuss the relationship between investor overconfidence and option pricing patterns, such as realized volatility, volatility spread, and volatility skew. I find option trading activities increase realized volatility and forward-looking volatility measure (VIX). They also tend to make out-of-the-money call options more expensive relative to the at-the-money counterparts over time, but they are associated with less expensive out-of-money call options cross-sectionally. In addition, there is evidence showing option traders are contrarians.

Table of Contents

List of Illustrations

List of Tables

Chapter 1

Market Returns, Trading Activities, and Investor Overconfidence

In recent years, trading activities in both equity and options market have been conspicuously intense. In equity markets, the New York Stock Exchange (NYSE) has reported the highest turnover rate of 138% with a total trading volume of over 800 million shares in 2008. The main corresponding derivative market, the Chicago Board of Options Exchange (CBOE), also had about 1.2 billion in total number of contracts traded. It translates into an annual total trading value of over 969 billion dollars. The heavy trading activities in those markets makes us wonder what reasons inspire investors to trade. Chordia, Roll, and Subrahmanyam (2011) address this question with the evidence from equity markets. While their findings suggest informational based trading by institutional traders is the major force driving the upward trend, it is still worthwhile to consider other possibilities, such as investor overconfidence.

1.1 Motivation

The understanding of reasons to trade is of interest not only because of heavy trading in both equity and options market but also because of higher volatilities associated with increasing trading volume in recent years. Although we cannot assert that higher trading volume is the cause of escalating asset price volatilities or the other way around, it is important to pursue whether there is a connection between these two concurrent phenomena. It is well known that there are two schools of theories that explain the reasons of trading. One posits people trade based on information, while the other states differences in opinion stimulate trading. They are not mutually exclusive theories and therefore both can potentially contribute to the trading activities observed. Intuitively, if people trade mainly based on true information, asset prices should gradually converge to their corresponding fundamental level. Therefore, the volatilities are more

likely to drop with trades. On the other hand, if investors trade because they do not agree with each other about asset prices, asset prices are less likely to converge and may be oscillating. Thus, volatilities will increase with trading volume.

Of all the potential explanations for reasons of trading, the aim of this study is to explore the contribution of investor confidence. Specifically, this study examines whether investors become overconfident if they have experienced positive past market performance. Scheinkman and Xiong (2003) present a theoretical framework in which investor overconfidence generates disagreement among market participants regarding asset fundamentals and therefore stimulates trading along with high price volatility. Those findings are the main motivation of this study. Given the flourishing trading volume accompanied by excessive volatility in recent years, I wonder if investors are getting more overconfident of their trading skills or their own "private" information, and consequently the level of disagreement in opinions about asset pricing has significantly increased. The patterns described in the seminal paper by Scheinkman and Xiong resemble the current trends in the stock markets, and therefore it is worthwhile to examine whether or not empirical evidence supports the overconfidence argument.

There have been some studies addressing this issue. The one closest to this study is Statman, Thorley, and Vorkink (2006). They find evidence that past stock market performance, dated back by several months, is positively correlated with current trading activities in the stock market. This finding supports the argument of investor overconfidence in the stock market. However, I am interested in the activities in the equity options market. Equity options are the derivatives of underlying stocks. Intuitively, their trading activities should be closely related to those in their underlying assets. If investors are overconfident about their trading skills or "private" information, will they trade exclusively in stocks and not in their derivatives? I doubt the answer would be

positive. It is interesting to see whether trading behaviors in options market are also subject to the psychological effects of investors.

There are two main purposes of this study. First, I would like to examine whether there is a positive relationship between past stock market returns and options trading volume, and then subsequently discuss potential explanations for the finding, specifically, investor overconfidence. If investor overconfidence is a plausible reason for options trading, it could open a door to a better understanding to the characteristics of option market participants. Second, I would like to test whether option prices are related to trading behavior. Current research on option pricing has suggested several types of patterns, including volatility spread and volatility skew, among others. These studies have presented profitable trading strategies and have also suggested ways to use the information to predict stock market's future performance. However, relatively little attention has been paid to the understanding of the "reasons" of those patterns. There must be reasons driving option prices to those patterns, and I believe one of the main reasons is psychological bias. Following the first topic of this study, I plan to examine the relationship between those option pricing patterns and options trading activities. To connect with investor overconfidence argument, I will also examine the relationship between the patterns and past market performance in the stock markets. If the overconfidence theory holds in the options market, I expect to find a positive relationship between options trading activities stimulated by investor overconfidence and option price volatilities. Also, those trading activities should be accompanied by more significant option pricing patterns, such as larger volatility spread.

1.2 Literature Review

1.2.1 Investor Overconfidence in Equity Market

Investor overconfidence has been well documented in the equity market. Daniel, Hirshleifer, and Subrahmanyam (1998) develop a theoretical framework that explains under- and overreactions in the equity market. Such circumstances could potentially attribute to the well-known psychological biases, including investor overconfidence and biased self-attribution. Odean (1998a) and Gervais and Odean (2001) also develop a model in which noise traders self-attribute the high returns experienced to their trading skills while the overall market also enjoys the similar results. Statman, Thorley, and Vorkink (2006) use a comprehensive dataset from the U.S. exchanges to empirically test the hypothesis, and confirm that past market returns are positively correlated with market turnover. They interpret this finding as the evidence of investor overconfidence. Kim and Nofsinger (2007) also present evidence that investor overconfidence exists not only in the U.S. market but also in the Japanese market. Griffin, Nardari, and Stulz (2007) extend the discussion to 46 different countries and find that many of them exhibit a positive relationship between stock turnover and past stock market return. Glaser and Weber (2009), on the other hand, suggest both past market returns and the returns of portfolio held by individual investors affect those investors' trading activities.

1.2.2 Options Trading

The above stream of literature, however, focuses exclusively on the equity market. Investors in the equity market are also likely traders in the options market, for hedging or speculating purposes. Though financial options were deemed as redundant securities in Black and Scholes (1973) and Cox, Ross, and Rubinstein (1979), options market have drawn significant attention in recent years. Ross (1976) and Arditti and John (1980), for example, present theoretical work to address the ability of options to

"complete" the market. Figlewski and Webb (1993) follow prior work and argue options market contributes to both transactional and informational efficiency by mitigating the effects of short-selling constraint in the equity markets. Furthermore, due to the higher leverage offered by financial derivatives, the ideas of using such instruments to exploit private information or to hedge underlying equity positions (or other securities) have intrigued researchers.

In a model presented by Easley, O'Hara, and Srinivas (1998), informed traders choose to trade in both equity and options market. Subsequent research also provides support to the existence of informed trading in options market [e.g., Amin and Lee (1997), Chakravarty, Gulen, and Mayhew (2004), Cao, Chen, and Griffin (2005), Pan and Poteshman (2006)]. Nevertheless, they do not rule out that uninformed/noise traders also actively participate in option trading. For example, Amin and Lee (1997) present evidence for informed trading surrounding earnings announcements. Cao et al. (2005) look at option trading prior takeovers. None of the above discusses trading in normal times. Chakravarty et al. (2004) show evidence of price discovery in options market, and the finding implies informed trading in options market. Pan and Poteshman (2006) also reach a similar conclusion. Contrary to the above studies, Stephan and Whaley (1990), Vijh (1990), Chan, Chung, and Johnson (1993), Chan, Chung, and Fong (2002), Choy and Wei (2012), and Muravyev, Pearson, and Broussard (2012) present evidence against informed trading in option market. As the debate on the information content in options trading still ongoing, we may turn to look at irrational part of trading.

1.2.3 Investor Overconfidence in Options Market

Pure noises in the market hardly help us understand the market better, but consistent biases do. There has been strong evidence that supports investor overconfidence in equity market, but little attention has been paid to options market in the

same regard. As large group of stock market investors also trade in options market, it is intuitive to wonder whether they are overconfident as well when trading in options market. Trading in options market demands closer attention from the investors because the leverage and margin requirement with options makes holding options for extended periods a hazardous strategy. Naturally, trading in options market may be deemed more challenging than trading in equity market. Early studies on human behavior conclude that most people are overconfident when performing challenge tasks [Alpert and Raiffa (1982), Lichtenstein, Fischhoff, and Phillips (1982), for example], and that even experts can be overconfident [Camerer (1995)]. Those studies provide enough incentive for reasonable doubt on the absence of overconfidence in options market.

Investors who have beliefs (regardless of whether the beliefs are correct or not) about future asset prices would find options market an attractive place to trade when implicit leverage in options is high and the liquidity in the option market is relatively high [Easley, O'Hara, and Srinivas (1998)]. In addition to informed trading, excessive trading activity in options market may possibly be the consequence of investor overconfidence. Literature suggests that informed investors can trade more effectively in options market [e.g., Jennings and Starks (1986), Mendenhall and Fehrs (1999)]; however, as discussed in the subsection 1.2.2, empirical studies have reached conflicting results on informed trading. For example, Chakravarty et al. (2004) find the contribution of option trading to price discovery to be about 17% on average, while Muravyev et al. (2012) document no "economically significant price discovery" occurs in the option market. The mixed evidence of informed trading may, in part, imply that investors have biased opinions about the information they hold. One of the potential investor's biases is overconfidence. One could imagine that an investor may bring her past success in the stock market to the options market so that she could profit (if she was right) more effectively, and become

overconfident in both markets. Investor overconfidence may lead investors to mistakenly overestimate the accuracy of the information they have, and consequently trade more [Odean (1998b), Statman, Thorley, and Vorkink (2006), among others]. If a considerable number of investors in options market are subject to overconfidence from time to time, especially in a bull market, it may not be that surprising to observe contradicting results in the studies of information content in options market. Thus, the study of overconfidence in options market not only helps us better understand the current trend in trading, but also it sheds light on the conflicting results in the informed trading studies.

1.3 Testing Hypotheses and Methodologies

1.3.1 Testing Hypothesis

One of the main purposes of this study is to examine whether investor overconfidence plays a role in options market. I propose the following testing hypotheses to address the issue.

H1: Past stock market returns are positively correlated with overall options trading activities.

In stock market, past success leads to investor overconfidence is one of the popular assumptions. Various authors work on the issue, and one common proxy used by them for investors' past success is past market return [e.g. Statman, Thorley, and Vorkink (2006), Glaser and Weber (2007, 2009)]. While participants in the options market are generally considered smarter and more informative, we cannot conclude that they are purely rational and are not subject to psychological bias. Furthermore, investors who participate in equity markets may also actively trade in options market. On one hand, they may protect their stock holdings by hedging in the options market; on the other hand,

options market provides another trading vehicle for them to execute their trading plans. It is interesting to examine whether investors bring past success in the equity markets to options market. If they do, we expect to observe a positive relationship between past stock market returns and options trading volume.

H2: Past stock market returns are positively correlated with call options trading activities.

If investors are trying to take speculative positions in options market, call options are more likely the trading vehicle they use. Stock markets in the United States have generally shown upward trend in the long run, and are expected to be so in a foreseeable future. While trading for the downside is a possibility for traders, relatively fewer investors use this strategy. Theoretically speaking, a call option is a better choice when taking a long position for speculation, because the potential profit is not limited. From empirical perspective, Lakonishok et al. (2006) report that the roughly daily open interests as a percentage of shares outstanding are 0.232%, 0.055%, 0.282%, and 0.072%, for call purchase, put purchase, call written, and put written, respectively. To initiate a trading, the main vehicle used by non-market maker traders is call option. Therefore, if investors are overconfident and trade more actively in options market, I expect that they use more call options.

H3: Past stock market returns are positively correlated with call/put ratio.

Consistent with the previous argument, call option is the major trading vehicle for investors speculating in the options market. In contrast, put options are usually used for hedging purpose. Put options offer downside risk protection, and consequently are commonly used in the connection with stock markets, such as the “protective put” strategy. If an investor is confident about her investment plan or about her “private” information and would like to take a speculation position, she is more likely to trade on call options rather than put options. From a different perspective, consider an investor

who is aggressive in stock market since she has enjoyed profit there. She may also wish to hedge her position in stock market using strategies such as protective put described above, especially when the market is relatively volatile. In such case, we may contrarily observe a lower call/put ratio after a bull market. It is interesting to examine which scenario is more likely with empirical evidence.

While my focus is on the relationship between past stock market performance and options market as a whole, it is worth to consider whether firm characteristics make differences. Statman et al. (2006) find stronger evidence of the lead-lag relationship between return and volume in smaller-capitalization stocks. They attribute this finding to the relatively larger role of individual investors, who are generally believed more easily subject to psychological biases. The coverage by stock analysts could also be a potential explanation to the finding, as low analyst coverage may indicate less information being disclosed to the market so that investors have little help to caliber their own judgment. Moreover, in the mainstream asset pricing theory, size effects have been identified [Banz (1981) and Fama and French (1992)]. Although there is no conclusive answer to what is/are underlying risk(s) causing size effects, scholars in this field have provided some potential candidates, including liquidity risk [Amihud and Mendelson (1986) and Liu (2006)] and information risk [Zhang (2006)]. As small firms are subject to higher (or more sources) of risks, investors of small firms have a better chance to misinterpret the risk contents and consequently find small firms attractive, compared to those of large firms who already find their investment less risky. In sum, there are more than enough reasons to look at whether investors of small-capitalization firms are more likely subject to overconfidence.

In addition to size, I also group firms according to their book-to-market equity ratio and financial analyst coverage, respectively. Firms with lower book-to-market equity

ratio are usually referred as growth or glamour stocks. Market participants usually pay more attention to these firms. Therefore, investor overconfidence may be easier accumulated for those firms. On the other hand, low stock analyst coverage may result in higher degree of information asymmetry. Thus, overconfidence may more likely apply to the firms with lower analyst coverage. The following hypothesis is proposed to investigate the matter:

H4: The relationships suggested in H1 to H3 are more pronounced in the options market for small-capitalization stocks, growth stocks, and stocks with lower analyst coverage.

1.3.2 Variables Selection and Empirical Methodologies

When considering the possible explanatory variables, I generally follow Statman et al. (2006) and use the two control variables market volatility, *misg*, and dispersion, *disp*. In addition, I also use the mean absolute deviation (*MAD*) measure in Bessembinder, Chan, and Seguin (1996). The first variable, *misg*, is the monthly return volatility for the value-weighted composite of all NYSE/AMEX nonfund common shares. I use the realized volatility estimates[1] in this study. The *misg* measure is similar to the *MAD* measure used by Bessembinder et al. (1996), according to Statman et al. (2006)[2]. The *MAD* measure is the value-weighted average of the beta-adjusted differences between firm returns and the market return. The *MAD* measure can be extended to account for size and growth effects, as suggested by Fama and French (1993). Specifically, I create two *MAD* measures. At any time *t*:

$$MAD_t = \sum_{j=1}^{N} W_j \left| R_{jt} - \beta_j R_{mt} \right| \text{ and,}$$

$$MAD3_t = \sum_{j=1}^{N} W_j \left| R_{jt} - \beta_j \left(R_{mt} - R_{ft} \right) - s_j SMB_t - h_j HML_t \right|$$

[1] I calculate month *t*'s volatility as $misg_t^2 = \sum_{\tau=1}^{T} r_\tau^2 + 2\sum_{\tau=1}^{T} r_\tau r_{\tau-1}$, where r_τ is day τ's return and *T* is the number of trading days in month *t*. Note that the calculation is the same with Statman et al. (2006) and French, Schwert, and Stambaugh (1987).

[2] See Statman et al. (2006) page 1540.

while $MAD3_t$ is the *MAD* measure adjusted for Fama and French's three factors, and SMB_t and HML_t is the return on the hedge portfolios based on size and book-to-market ratio, respectively. Return dispersion, *disp*, is the monthly cross-sectional standard deviation of returns for the same list of stocks used for calculating *misg*. Return dispersion measures idiosyncratic risk in stocks, and therefore accounts for potential trading activities due to the needs of portfolio rebalancing.

I begin with the use of OLS regression to study the interactions between past stock market performance and options trading volume. The model is as following:

$$Vol_t = \alpha + \beta_1 misg_t + \beta_2 disp_t + \beta_3 Ret_{t-1,t-k} + \varepsilon_t$$

where Vol_t represents the trading volume measures and $Ret_{t-1,t-k}$ is the geometric average market rate of returns over the past *k* months. In this study, I use several trading volume measures. It is commonly agreed that numbers of contracts (shares) traded are very noisy measure for trading volume. On the other hand, turnover is used in equity markets by some of the recent studies, such as Lo and Wang (2000) and Statman et al. (2006). To make a similar adjustment for options market, I first adopt the turnover measure similar to Choy and Wei (2012), which is trading volume divided by open interest[3]. For robustness check, I also use other measures to strengthen the empirical findings in the next section.

Regarding the lagged market returns, there is no specified time frame in formal overconfidence theories. However, it is intuitive that investors require a period of time to build up their confidence in trading. While Statman et al. (2006) choose to let the VAR model to determine the appropriate lags in terms of market returns, I believe cumulative

[3] Specifically, the measure is calculated as (number of contracts traded * 100) / number of contract as open interest

returns may be a more appropriate proxy for investor confidence. Therefore, I will test the model using lagged returns which are averaged over various periods in the past.

1.4 Data Description and Empirical Analysis

1.4.1 Data Description

Data used in this study comes from three different databases. Daily option trading data is extracted from OptionMetrics. Daily stock prices, returns, trading volume, and shares outstanding are from the Center for Research in Security Prices (CRSP), while book value of the stock is obtained from Capital IQ Compustat. The OptionMetrics dataset covers the period from January 1996 to December 2011, and therefore defines the sample period. I choose to use monthly observations in the following analysis to mitigate the potential noises in the data with daily frequency. Additionally, all the variables are aggregated across all the firms in my sample, as the main target of this study is the options market as a whole.

This study focuses on equity options traded in the Chicago Board Option Exchange (CBOE), and excludes all the indexes, Depository Receipts (DRs), and funds. Also, individual stocks traded on NASDAQ are excluded from the study because of the different practice in calculating trading volume in dealers market.

Table 1.1 summarizes the basic summary statistics as well as trend fit for trading activities in the dataset. Trading volume on options (VOL_O)[4] and dollar value of trading volume on options (DVOL_O) are first aggregated within an underlying equity and then across all the underlying firms in our sample, and at last the daily aggregated volume is average over the month. In other words, the volume measures are daily average trading

[4] This measure is the number of contracts multiplied by 100.

Table 1-1 Summary Statistics

Panel A: Sample Characteristics

Year	Number of Firms	VOL_O (million shares)	DVOL_O (million dollars)	OI (million contracts)	CAP (million dollars)	TO_O (%)	TO_S (%)
1996	474	31.88	106.55	6.97	3920.77	4.6791	0.3175
1997	801	49.48	193.93	11.11	5945.51	4.5390	0.3411
1998	1005	63.27	264.33	15.28	7761.65	4.1890	0.3639
1999	1180	79.72	426.30	20.40	9444.88	3.9635	0.3825
2000	1146	102.90	518.15	27.35	10132.73	3.7991	0.4371
2001	961	118.82	397.27	35.08	9681.28	3.4399	0.4651
2002	980	133.41	327.21	45.00	8744.71	3.0145	0.5185
2003	1099	152.44	328.20	54.53	8643.06	2.8166	0.5115
2004	1064	190.92	422.06	68.25	10493.33	2.8354	0.5059
2005	1166	250.93	707.92	80.66	11744.83	3.1266	0.5376
2006	1226	335.14	1045.13	94.93	13079.94	3.5667	0.6322
2007	1366	435.48	1532.31	119.59	14827.43	3.6836	0.8207
2008	1430	551.31	1991.41	134.38	12345.15	4.1211	1.2818
2009	1510	646.01	1335.48	127.02	9599.04	5.1826	1.4524
2010	1542	595.93	1224.66	135.83	11932.99	4.4466	1.1511
2011	1608	619.78	1378.66	146.00	13395.32	4.2721	1.0322

Table 1-1—*Continued*

Panel B: Summary Statistics for Trading Volumes (All Years)

Section 1: All options			
	VOL_O (million shares)	DVOL_O (million dollars)	TO_O (%)
Mean	272.34	762.47	3.85
Median	171.20	524.20	3.76
Std. dev.	222.63	607.44	0.91
Section 2: Call Options			
	VOL_C	DVOL_C	TO_C
Mean	167.59	487.92	4.10
Median	101.59	370.58	3.97
Std. dev.	135.97	383.28	1.02
Section 3: Put Options			
	VOL_P	DVOL_P	TO_P
Mean	104.75	274.56	3.50
Median	65.20	170.16	3.40
Std. dev.	89.65	296.34	0.89
Section 4: Underlying Stocks			
	VOL_S	DVOL_S	TO_S
Mean	2091.13	64104.90	0.67
Median	1513.76	47977.95	0.52
Std. dev.	1646.64	40221.36	0.37

Panel C: Explanatory Variables

Variable	*RET*	*disp*	*misg*	*MAD*	*MAD3*
Observations	192	192	192	192	192
Mean (%)	0.49	14.68	5.03	1.36	1.34
Median (%)	0.97	13.38	4.23	1.20	1.19
SD (%)	4.71	4.82	2.79	0.55	0.54
Skewness	-0.59	2.63	2.72	1.29	1.29
Kurtosis	0.74	11.27	12.40	1.11	1.16
Minimum (%)	-16.94	9.00	1.14	0.71	0.72
Maximum (%)	10.77	45.93	23.35	3.30	3.30

Table 1-1—*Continued*

Panel D: Trend Fits

Section 1: All Options

	Share Volume[5]		Dollar Volume		Turnover	
Variable	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.
Linear	8.198	6.478	35.789	4.613	0.027	1.166
Quadratic	-0.139	-6.963	-0.609	-4.549	-0.001	-3.322
Cubic	0.001	8.113	0.003	4.833	0.000	4.303
Quartic	-0.000	-8.405	-0.000	-4.865	-0.000	-4.680
Adjusted R-square	0.9456		0.7223		0.5027	

Section 2: Call Options

	Share Volume		Dollar Volume		Turnover	
Variable	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.
Linear	4.649	5.670	204.606	2.939	0.020	0.803
Quadratic	-0.077	-5.620	-3.398	-2.809	-0.001	-2.793
Cubic	0.000	6.254	0.017	3.039	0.000	3.667
Quartic	-0.000	-6.174	-0.000	-3.010	-0.000	-3.972
Adjusted R-square	0.9332		0.6640		0.4561	

Section 3: Put Options

	Share Volume		Dollar Volume		Turnover	
Variable	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.
Linear	4.649	5.552	20.718	4.161	0.034	1.321
Quadratic	-0.077	-5.954	-0.360	-4.158	-0.001	-3.117
Cubic	0.000	6.815	0.002	4.320	0.000	3.918
Quartic	-0.000	-7.018	-0.000	-4.370	-0.000	-4.224
Adjusted R-square	0.9099		0.5199		0.3792	

Section 4: Underlying Stocks

	Share Volume		Dollar Volume		Turnover	
Variable	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.
Linear	95.768	5.764	2469.512	6.835	0.024	4.873
Quadratic	-1.511	-5.729	-37.803	-6.444	-0.000	-5.279
Cubic	0.008	6.044	0.209	6.762	0.000	5.695
Quartic	-0.000	-5.986	-0.000	-6.745	-0.000	-5.755
Adjusted R-square	0.8760		0.8811		0.7968	

[5] All trading volume measures are in million shares/dollars.

volume for the universe of our sample over a given month. The turnover measures (TO_O for options and TO_S for underlying stocks) are also constructed in a similar way. I scale the daily observations of option trading volume (VOL_O) for the whole sample by the aggregated open interest (OI) for the whole sample. As of stocks, we calculate daily stock trading volume in the same manner as VOL_O, and then scale it by the aggregated numbers of shares outstanding.

Panel A summarizes the average figures for each of the main variables used in this study. As more stocks have options listed on the CBOE, option trading volume, both in the number of contracts and in dollar value, has inflated considerably since 1996. After 2000, the growth of number of firms in the sample stabilizes, while trading volume still grow relatively fast. From 2001 until 2011, the number of firms increases by around 67.33%, while the trading volume grows by 421.61% and by 247.03% in number of contracts and in dollar value, respectively. It is worth noting that the dollar value of trades had accumulated during the “bubble years”, reached peak in the year that the bubble burst, and then plummeted in following years. This phenomenon occurred in both 2000 and 2008. Looking at those patterns only, one may already perceive the potential of overconfidence in the market. Alternatively, this might also be the evidence of investors’ fears that keep them away from actively trading in the market.

Panel B, generally speaking, shows that underlying stock markets are much more active. Total size of trading is about 7.7 times more in stock market, while the total money involved in the trading is 84 times more (0.76 billion in options market versus 64.10 billion in stock market on average per month). Within options market, trading on call options is more active than on put options. On the other hand, put options is more volatile than call options in trading activities over time, as indicated by higher coefficient of variance in two out of three trading measures (0.85 vs. 0.81 for trading volume, 1.08

vs. 0.79 for dollar value of trading volume, and 0.25 vs. 0.25 for turnover rate). Given the fact that put options are mainly used for hedging, the difference might suggest hedging needs change more than speculating activities do. Possible reasons may be 1) investors are more educated over time so they are more cautious about managing risks over time, or 2) investors' attitude toward risks changes considerably over time. In the second case, that investors sometimes are more willing to take in risks could possibly be an indication of overconfidence. If investors are overconfident on the information they have, they might be less cautious about risk exposure on their positions and therefore conduct less hedging activities.

Panel C summarizes the descriptive statistics for all explanatory variables. Except for lagged market return, all the independent variables are skewed to the right. The other noticeable statistic is kurtosis. *misg* has a significant positive kurtosis, which suggests clustered observations. Panel D is a simple trend fitting. Following Chordia et al. (2011), we fit each series to orthogonal Legendre polynomials for the period 1996-2011. The trend fit a normal increasing trend for most of cases, but it is worth noting that while there is a significant trend in turnover rate in the underlying stock market, the turnover measure in options market exhibits little trend patterns. Considering our option turnover measure is trading volume scaled by open interests, this may reflect longer holding period on options later in our sample, which consequently causes higher open interests. Looking back on Panel A, one may observe that as trading volume increases substantially each year, option turnover rate exhibits an U-shape pattern from 1996 to 2011. The lowest point was during 2003 – 2005, when the U.S. equity market was climbing stably. The U.S. market was just recovered from the previous bubble era, which might be the reason that prevents investors from trading aggressively in the options market. Interestingly, the equity market does not show the same pattern, but the growing

trend in stock turnover did slow down a bit during the same period. This further stimulates our interests in studying psychological factors in the options market trading. Comparing Panel D with Panel E, where observations in and after 2008 are excluded from analysis, one may quickly find there are significant differences on put options and on underlying stocks. Before 2008, there were decreasing trend in trading activities for put options (all three measures) and for underlying stocks (share volume and turnover). However, once observations after 2008 are included, the trends turn around become positive. Therefore, it is worth to look these two samples (all years vs. years before 2008) in the following analyses.

1.4.2 Empirical Analysis

1.4.2.1. Full Sample

I first begin with simple OLS analysis on option turnover rate. I first regress option turnover against *misg*, the market volatility over a month, and *disp*, the cross-sectional standard deviation of stock returns across all the sample firms. To check for robustness, the mean absolute deviation (*MAD*[6]) measure by Bessembinder et al. (1996) is used to replace *misg* measure. The regression results are summarized in Table 1.2 and 1.3, repsectively. One may clearly see from the table that past cumulative market return, the measure of overconfidence used in this study, has positive impact on future option turnover. In 13 out of 16 regressions, coefficients on lagged cumulative lagged market returns are positive and statistically significant at 5% level. The only ones that are not statistically significant at 10% level are returns lagged by 1 month. In addition, the table shows that the coefficient on *lret* increases with the length of time horizon used to calculate average market returns. It increases faster initially, and slows down after three months. The finding may suggest that on average it takes about 2 to 3 months for

[6] The *MAD* measure used in the table is calculated as following:
$\sum_{j=1}^{N} w_j \left| R_{jt} - \beta_j \cdot RP_m - h_j \cdot HML - s_j \cdot SMB \right|$, where the weights are proportional to the market value of the firm.

investors' overconfidence to fully reflect in the market. It is consistent with the intuition that it takes time for people to build up confidence and that the confidence does not dissipate easily once established.

Table 1-2 OLS regression on option turnover rate

Cumulative Return		Intercept	*trend*	***lret***	*disp*	*ldisp*	*misg*	*lmisg*
1 MONTH	Coefficient	2.869	0.001	**2.779**	4.004	1.995	7.497	-7.564
	P-value	0.000	0.482	**0.109**	0.215	0.465	0.010	0.006
2 MONTH	Coefficient	2.741	0.001	**5.787**	4.537	1.366	7.712	-5.459
	P-value	0.000	0.409	**0.017**	0.162	0.623	0.016	0.051
3 MONTH	Coefficient	2.565	0.001	**9.171**	4.452	1.907	7.831	-4.188
	P-value	0.000	0.286	**0.001**	0.158	0.501	0.014	0.128
4 MONTH	Coefficient	2.474	0.001	**10.604**	4.655	2.332	7.750	-4.527
	P-value	0.000	0.233	**0.013**	0.159	0.412	0.005	0.132
5 MONTH	Coefficient	2.421	0.002	**11.038**	4.905	2.679	7.497	-5.152
	P-value	0.000	0.217	**0.029**	0.186	0.357	0.009	0.106
6 MONTH	Coefficient	2.303	0.002	**12.698**	5.576	2.859	7.031	-5.277
	P-value	0.000	0.176	**0.010**	0.127	0.335	0.018	0.073
9 MONTH	Coefficient	2.068	0.002	**16.946**	5.912	4.059	7.096	-6.365
	P-value	0.000	0.094	**0.002**	0.097	0.156	0.011	0.019
12 MONTH	Coefficient	1.699	0.003	**25.084**	6.245	5.276	7.263	-5.979
	P-value	0.000	0.022	**0.000**	0.058	0.046	0.006	0.014

I then look at the explanatory variables. Similar to the findings in Statman, Thorley, and Vorkink (2006), *misg* measure also plays a significant role on the trading in options market. When the overall market is more volatile, there are more trading activities in options market. This result suggests *misg* measure may capture the hedging activities in react to overall market variations. However, *disp* measure does not show much of the significance in this specific analysis, which suggests the information coming from individual firms shows a rather mixed effect to the options trading overall. The results are similar when we use *MAD* instead of *misg* in the regression. *MAD* has significant and positive effect on option trading, while *disp* displays rather insignificant influence. Note

that we used *MAD* measures adjusted for Fama-French three factors in the table, but the results are similar using *MAD* measures adjusted for beta only. While I find that using either *misg* or *MAD* yields similar conclusion. The coefficients on lagged cumulative market return variable are relatively smaller when *MAD* is used in the regression.

Table 1-3 OLS regression on turnover rate (alternative model)

Cumulative Return		Intercept	*trend*	***lret***	*disp*	*ldisp*	*MAD*	*lMAD*
1 MONTH	Coefficient	2.939	0.000	**2.350**	4.220	3.629	84.508	-105.577
	P-value	0.000	0.844	**0.137**	0.227	0.158	0.000	0.000
2 MONTH	Coefficient	2.806	0.001	**4.512**	4.660	3.048	83.213	-96.386
	P-value	0.000	0.623	**0.046**	0.182	0.274	0.000	0.000
3 MONTH	Coefficient	2.644	0.001	**7.110**	4.567	3.318	81.168	-88.095
	P-value	0.000	0.407	**0.010**	0.187	0.252	0.000	0.000
4 MONTH	Coefficient	2.573	0.001	**8.358**	4.716	3.637	80.022	-87.768
	P-value	0.000	0.370	**0.039**	0.189	0.198	0.000	0.000
5 MONTH	Coefficient	2.539	0.001	**8.876**	4.948	3.972	79.522	-90.690
	P-value	0.000	0.407	**0.071**	0.211	0.155	0.000	0.000
6 MONTH	Coefficient	2.438	0.001	**10.537**	5.570	4.130	76.807	-90.100
	P-value	0.000	0.377	**0.030**	0.149	0.146	0.000	0.000
9 MONTH	Coefficient	2.229	0.001	**14.786**	5.962	5.263	76.872	-94.514
	P-value	0.000	0.272	**0.008**	0.115	0.049	0.000	0.000
12 MONTH	Coefficient	1.901	0.002	**22.246**	6.486	6.403	73.269	-92.264
	P-value	0.000	0.102	**0.000**	0.062	0.008	0.000	0.000

The empirical evidence above supports my first hypothesis (H1), and therefore is consistent with overconfidence theory. To further investigate this issue, I look at call and put option independently to test the second hypothesis (H2), and I also run the same regression with a new dependent variable of call to put (C/P) ratio to test the third hypothesis (H3).

Table 1-4 OLS regression on turnover rate – call and put options

Panel A: Call		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	3.223	0.002	**6.050**	4.080	0.966
	P-value	0.000	0.128	**0.002**	0.091	0.653
2 MONTH	Coefficient	2.920	0.003	**11.347**	5.202	2.567
	P-value	0.000	0.064	**0.000**	0.029	0.253
3 MONTH	Coefficient	2.709	0.003	**15.981**	6.033	3.150
	P-value	0.000	0.028	**0.000**	0.007	0.182
4 MONTH	Coefficient	2.577	0.003	**18.644**	6.767	2.914
	P-value	0.000	0.016	**0.000**	0.003	0.148
5 MONTH	Coefficient	2.509	0.003	**19.604**	7.410	2.121
	P-value	0.000	0.017	**0.000**	0.004	0.303
6 MONTH	Coefficient	2.343	0.004	**21.951**	8.656	1.102
	P-value	0.000	0.010	**0.000**	0.001	0.604
9 MONTH	Coefficient	2.161	0.004	**26.680**	9.714	0.254
	P-value	0.000	0.004	**0.000**	0.000	0.910
12 MONTH	Coefficient	1.906	0.005	**34.035**	10.639	0.358
	P-value	0.000	0.000	**0.000**	0.000	0.868
Panel B: Put		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	2.631	-0.001	**0.748**	3.053	10.773
	P-value	0.000	0.263	**0.615**	0.067	0.000
2 MONTH	Coefficient	2.553	-0.001	**2.304**	3.230	11.488
	P-value	0.000	0.298	**0.262**	0.056	0.000
3 MONTH	Coefficient	2.500	-0.001	**3.469**	3.417	11.706
	P-value	0.000	0.340	**0.178**	0.037	0.000
4 MONTH	Coefficient	2.481	-0.001	**3.841**	3.554	11.579
	P-value	0.000	0.355	**0.287**	0.031	0.000
5 MONTH	Coefficient	2.488	-0.001	**3.595**	3.626	11.278
	P-value	0.000	0.350	**0.384**	0.031	0.000
6 MONTH	Coefficient	2.436	-0.001	**4.455**	3.931	11.190
	P-value	0.000	0.387	**0.297**	0.021	0.000
9 MONTH	Coefficient	2.462	-0.001	**4.092**	3.898	10.810
	P-value	0.000	0.386	**0.434**	0.027	0.000
12 MONTH	Coefficient	2.329	-0.001	**7.332**	4.407	11.093
	P-value	0.000	0.547	**0.193**	0.012	0.000

Table 1.4 summarizes similar regressions on call and put option turnover separately. Panel A shows the regressions on call options, while panel B presents the ones on put options. It is apparent that call options account most of the effects from the previous discovery. All the coefficients on lagged market return are statistically significant, and are higher than their corresponding figure in Table 1.3. However, on the other hand, regressions on put option turnover show virtually no pattern in the same regard. None of the coefficients on lagged market return is statistically significant, while all of the coefficients are negative. These results suggest that the lagged market returns are more tied to the trading activities in call options, but not in put options. It is worthwhile to note that in the regression for call option turnover, *misg* measure is not statistically significant. The results are consistent with the argument that *misg* captures hedging activities against market wide variations, and the main trading vehicle for such purpose is put options. The regressions on put options confirm the point, given all positive and significant coefficients on *misg* measure. It is more interesting to find *disp* measure is significant in both sets of regressions, while it is not when we put call and put options together. Although a satisfactory explanation may not be easily offered, I suspect that this phenomenon may be the results of different trading strategies using call and put options in react to information regarding individual companies.

In the regression on C/P ratios, lagged market returns always show positive and statistically significant coefficients. As shown in Table 1.5, Panel A, the coefficients show that past market returns are positively related to C/P ratios, which suggests higher past market returns lead to more trading activities on call options relative to that on put options. Similar to the findings in Table 1.2, the largest coefficient is on market return lagged by two months. Panel B describes the same pattern, but focus on the dollar value of the trading, instead of the number of contracts traded. All coefficients on lagged market

returns are positive and statistically significant, and again, the largest coefficient is on the market return lagged by two months. Generally speaking, Table 1.5 further supports the results in the previous table, and is also consistent with overconfidence hypothesis.

The empirical analyses so far bolster the overconfidence theory. We then conduct additional tests to further investigate the issue. The turnover ratio in option trading used in the previous analyses may not be the only way to measure option trading activities. Therefore, I also conduct other analysis using different measures of option trading to confirm the results above. One interesting measure to look at is the ratio of option trading volume over the underlying stock trading volume (O/S ratio). Earlier study by Statman et al. (2006) concludes past market returns have positive impacts on future equity trading turnover. One may wonder whether heavier trading in options market is just a response to what is happening in the equity market or it is because investors in options market are overconfident. The investor overconfidence theory would seem more convincing if O/S ratio increases with past market return.

Table 1-5 OLS regression on call-to-put (C/P) ratio

Panel A: C/P (shares)		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	2.228	-0.004	**2.590**	0.136	-2.468
	P-value	0.000	0.000	**0.000**	0.775	0.009
2 MONTH	Coefficient	2.114	-0.004	**4.505**	0.602	-1.985
	P-value	0.000	0.000	**0.000**	0.182	0.012
3 MONTH	Coefficient	2.043	-0.003	**6.072**	0.909	-1.875
	P-value	0.000	0.000	**0.000**	0.025	0.014
4 MONTH	Coefficient	1.996	-0.003	**7.000**	1.179	-1.995
	P-value	0.000	0.000	**0.000**	0.006	0.015
5 MONTH	Coefficient	1.937	-0.003	**8.078**	1.519	-2.071
	P-value	0.000	0.000	**0.000**	0.006	0.015
6 MONTH	Coefficient	1.870	-0.003	**9.004**	2.025	-2.500
	P-value	0.000	0.000	**0.000**	0.000	0.001

Table 1-5—*Continued*

9 MONTH	Coefficient	1.695	-0.003	**13.051**	2.853	-2.516
	P-value	0.000	0.000	**0.000**	0.000	0.003
12 MONTH	Coefficient	1.603	-0.002	**15.925**	3.180	-2.557
	P-value	0.000	0.000	**0.000**	0.000	0.002
Panel B: C/P (dollars)		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	3.834	-0.005	**10.031**	-3.182	-9.856
	P-value	0.000	0.002	**0.000**	0.135	0.011
2 MONTH	Coefficient	3.393	-0.005	**17.412**	-1.381	-8.007
	P-value	0.000	0.004	**0.000**	0.488	0.018
3 MONTH	Coefficient	3.181	-0.004	**22.092**	-0.305	-8.192
	P-value	0.000	0.013	**0.000**	0.853	0.010
4 MONTH	Coefficient	3.128	-0.004	**22.927**	0.397	-9.567
	P-value	0.000	0.020	**0.000**	0.815	0.007
5 MONTH	Coefficient	3.067	-0.004	**23.626**	1.122	-10.691
	P-value	0.000	0.025	**0.000**	0.580	0.003
6 MONTH	Coefficient	2.894	-0.004	**25.914**	2.527	-12.043
	P-value	0.000	0.038	**0.000**	0.219	0.000
9 MONTH	Coefficient	2.371	-0.003	**37.969**	4.987	-12.025
	P-value	0.000	0.123	**0.000**	0.012	0.001
12 MONTH	Coefficient	2.080	-0.002	**46.849**	6.027	-12.077
	P-value	0.000	0.315	**0.000**	0.001	0.001

Table 1.6 concludes the regressions using O/S ratio as dependent variable. Without surprises, lagged market returns are positively contributed to O/S ratio in terms of shares traded. However, the evidence is generally weaker in terms of trading dollar value in Panel B. Inspired from previous results, I further dissect option trading into calls and puts, and rerun the regressions. The results are presented in panel C through F. In general, panel C and D show that past market returns are positively related to trading on call options, in terms of both shares and dollar value, while panel E and F exhibit the opposite behaviors in trading on put options. The interesting results might suggest when market experienced positive past market returns, investors tend to trade less frequently

on hedging tools (put options); alternatively, the results might suggest negative past market returns encourage investors to hedge more using put options. These results are consistent with overconfidence theory as well, and are intuitively reasonable. Furthermore, figures in Panel D and F also help explain why coefficients in Panel B are not statistically significant. After a bull market, investors tend to put more money on call options, evidenced by positive coefficients on *lret* in Panel D, while withdraw money from put options, shown by negative coefficient on *lret* in Panel F. When I look at options market as a whole, the effects on call and put options cancel out each other, and therefore turn out to be less significant in Panel B. Thus, the evidence presented in Table 1.6 further strengthens the overconfidence argument.

1.4.2.2. Sample Sorted into Portfolios

While we find evidence that supports overconfidence theory in previous analyses, we would like to extend the study by segregate our sample firms into subsamples for two reasons. First, Statman, Thorley, and Vorkink (2006) find that the positive relationship between prior market return and subsequent trading turnover in equity market is more pronounced in small-cap stocks. They attribute this finding to higher individual holdings in those firms. We would like to examine whether we would find the same evidence in the options market. Second, we would like to know whether our findings in the prior subsection are more pronounced on firms with certain characteristics other than firm size. If the main driving force of the finding is investor overconfidence, we should expect to see stronger evidence from the groups that are more likely subject to behavioral biases. In the following subsections, we break the sample down according to size, book-to-market ratio, and stock analysts coverage, respectively.

Table 1-6 OLS regression on option over stock trading volume (O/S)

Panel A: O/S (shares)		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	0.136	0.000	**0.047**	-0.123	-0.307
	P-value	0.000	0.000	**0.078**	0.002	0.000
2 MONTH	Coefficient	0.134	0.000	**0.082**	-0.115	-0.297
	P-value	0.000	0.000	**0.048**	0.003	0.000
3 MONTH	Coefficient	0.132	0.000	**0.122**	-0.108	-0.290
	P-value	0.000	0.000	**0.010**	0.004	0.000
4 MONTH	Coefficient	0.131	0.000	**0.135**	-0.103	-0.295
	P-value	0.000	0.000	**0.011**	0.006	0.000
5 MONTH	Coefficient	0.131	0.000	**0.137**	-0.099	-0.302
	P-value	0.000	0.000	**0.054**	0.013	0.000
6 MONTH	Coefficient	0.129	0.000	**0.158**	-0.090	-0.308
	P-value	0.000	0.000	**0.037**	0.024	0.000
9 MONTH	Coefficient	0.125	0.000	**0.258**	-0.070	-0.304
	P-value	0.000	0.000	**0.004**	0.077	0.000
12 MONTH	Coefficient	0.121	0.000	**0.351**	-0.057	-0.300
	P-value	0.000	0.000	**0.003**	0.121	0.000
Panel B: O/S (dollars)		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	0.008	0.000	**0.009**	0.008	0.001
	P-value	0.000	0.000	**0.040**	0.087	0.954
2 MONTH	Coefficient	0.008	0.000	**0.019**	0.009	0.004
	P-value	0.000	0.000	**0.008**	0.038	0.713
3 MONTH	Coefficient	0.007	0.000	**0.022**	0.010	0.003
	P-value	0.000	0.000	**0.012**	0.035	0.794
4 MONTH	Coefficient	0.008	0.000	**0.017**	0.010	-0.001
	P-value	0.000	0.000	**0.070**	0.042	0.964
5 MONTH	Coefficient	0.008	0.000	**0.013**	0.010	-0.003
	P-value	0.000	0.000	**0.220**	0.046	0.829
6 MONTH	Coefficient	0.008	0.000	**0.015**	0.011	-0.003
	P-value	0.000	0.000	**0.203**	0.041	0.790
9 MONTH	Coefficient	0.007	0.000	**0.029**	0.014	-0.002
	P-value	0.000	0.000	**0.040**	0.017	0.862
12 MONTH	Coefficient	0.006	0.000	**0.045**	0.017	-0.001
	P-value	0.000	0.000	**0.009**	0.006	0.940

Table 1-6—*Continued*

Panel C: C/S (shares)		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	0.093	0.000	**0.070**	-0.076	-0.237
	P-value	0.000	0.000	**0.001**	0.012	0.000
2 MONTH	Coefficient	0.090	0.000	**0.121**	-0.063	-0.224
	P-value	0.000	0.000	**0.000**	0.031	0.000
3 MONTH	Coefficient	0.087	0.000	**0.167**	-0.055	-0.219
	P-value	0.000	0.000	**0.000**	0.042	0.000
4 MONTH	Coefficient	0.086	0.000	**0.190**	-0.047	-0.224
	P-value	0.000	0.000	**0.000**	0.087	0.000
5 MONTH	Coefficient	0.085	0.000	**0.208**	-0.040	-0.229
	P-value	0.000	0.000	**0.001**	0.200	0.000
6 MONTH	Coefficient	0.083	0.000	**0.236**	-0.026	-0.239
	P-value	0.000	0.000	**0.000**	0.398	0.000
9 MONTH	Coefficient	0.078	0.000	**0.357**	-0.002	-0.237
	P-value	0.000	0.000	**0.000**	0.958	0.000
12 MONTH	Coefficient	0.075	0.000	**0.450**	0.010	-0.237
	P-value	0.000	0.000	**0.000**	0.676	0.000
Panel D: C/S (dollars)		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	0.007	0.000	**0.017**	0.002	-0.023
	P-value	0.000	0.007	**0.000**	0.562	0.005
2 MONTH	Coefficient	0.007	0.000	**0.031**	0.005	-0.019
	P-value	0.000	0.002	**0.000**	0.139	0.007
3 MONTH	Coefficient	0.006	0.000	**0.037**	0.007	-0.020
	P-value	0.000	0.002	**0.000**	0.062	0.005
4 MONTH	Coefficient	0.006	0.000	**0.036**	0.008	-0.023
	P-value	0.000	0.002	**0.000**	0.052	0.003
5 MONTH	Coefficient	0.006	0.000	**0.036**	0.009	-0.025
	P-value	0.000	0.002	**0.000**	0.045	0.002
6 MONTH	Coefficient	0.006	0.000	**0.042**	0.011	-0.027
	P-value	0.000	0.001	**0.000**	0.016	0.000
9 MONTH	Coefficient	0.005	0.000	**0.062**	0.016	-0.027
	P-value	0.000	0.000	**0.000**	0.001	0.001
12 MONTH	Coefficient	0.004	0.000	**0.082**	0.018	-0.026
	P-value	0.000	0.000	**0.000**	0.000	0.001

Table 1-6—*Continued*

Panel E: P/S (shares)		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	0.043	0.000	**-0.023**	-0.047	-0.070
	P-value	0.000	0.000	**0.028**	0.000	0.000
2 MONTH	Coefficient	0.044	0.000	**-0.039**	-0.051	-0.073
	P-value	0.000	0.000	**0.020**	0.000	0.001
3 MONTH	Coefficient	0.044	0.000	**-0.045**	-0.053	-0.071
	P-value	0.000	0.000	**0.028**	0.000	0.002
4 MONTH	Coefficient	0.045	0.000	**-0.055**	-0.056	-0.071
	P-value	0.000	0.000	**0.010**	0.000	0.001
5 MONTH	Coefficient	0.046	0.000	**-0.071**	-0.060	-0.073
	P-value	0.000	0.000	**0.002**	0.000	0.001
6 MONTH	Coefficient	0.046	0.000	**-0.078**	-0.064	-0.069
	P-value	0.000	0.000	**0.002**	0.000	0.001
9 MONTH	Coefficient	0.047	0.000	**-0.099**	-0.068	-0.067
	P-value	0.000	0.000	**0.005**	0.000	0.001
12 MONTH	Coefficient	0.047	0.000	**-0.099**	-0.067	-0.064
	P-value	0.000	0.000	**0.032**	0.000	0.001
Panel F: P/S (dollars)		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	0.001	0.000	**-0.009**	0.006	0.023
	P-value	0.072	0.000	**0.001**	0.070	0.000
2 MONTH	Coefficient	0.001	0.000	**-0.012**	0.004	0.023
	P-value	0.020	0.000	**0.000**	0.146	0.001
3 MONTH	Coefficient	0.001	0.000	**-0.015**	0.003	0.023
	P-value	0.006	0.000	**0.000**	0.173	0.001
4 MONTH	Coefficient	0.001	0.000	**-0.019**	0.003	0.023
	P-value	0.001	0.000	**0.000**	0.296	0.000
5 MONTH	Coefficient	0.002	0.000	**-0.023**	0.002	0.023
	P-value	0.000	0.000	**0.000**	0.583	0.000
6 MONTH	Coefficient	0.002	0.000	**-0.027**	0.000	0.024
	P-value	0.000	0.000	**0.000**	0.967	0.000
9 MONTH	Coefficient	0.002	0.000	**-0.034**	-0.002	0.025
	P-value	0.000	0.000	**0.000**	0.524	0.000
12 MONTH	Coefficient	0.002	0.000	**-0.037**	-0.002	0.025
	P-value	0.000	0.000	**0.000**	0.491	0.000

1.4.2.2.1. Subsample based on size. In this subsection, I sorted sample firms into portfolios according to their market capitalization, and then create a panel data set. Thus, I can run regressions that allow the coefficients on lagged market return to change across size portfolios.

First, I sort the firms into two size portfolios, based on the median size of all NYSE/AMEX listed firms. Therefore, the BIG portfolio contains the firms whose size is greater than the median of all the NYSE/AMEX listed firms in a specific year. This way, I could better compare the size of the firms in portfolios with the whole market. As most would guess, firms with equity options traded in the CBOE are relatively large in market capitalization. More specifically, the numbers of firms in each portfolio range larger during earlier years in my sample (50 firms in the SMALL portfolio versus 424 firms in the BIG portfolio in the beginning of year 1996, for example), while the numbers get much closer toward the end of the sample period (573 firms in the SMALL portfolio versus 1140 firms in the BIG portfolio at the end of 2011). Table 1.7 summarizes the results. The results are mixed. The coefficients on *lret* are statistically significant in 7 out of 8 regressions at 10% level; on the other hand, the cross-effect terms (D_{size} * *lret*) are all positive but not statistically significant. From this table, one may hardly reach any conclusion on the matter that firm size has any effect on investor overconfidence. On the other hand, Statman et al. (2006) find in equity market that past market returns are positively related to trading on small-cap stocks as well as large-cap stock, but the effects are more significant on small-cap stocks.

Table 1-7 OLS regression on turnover rate, where companies are sorted by size (full sample)

Cumulative Return		*Intercept*	*trend*	***lret***	*disp*	*misg*	D_{size}	$\boldsymbol{D_{size} * lret}$
1 MONTH	Coefficient	3.560	0.000	**2.436**	1.930	0.540	-0.353	**2.910**
	P-value	0.000	0.885	**0.144**	0.178	0.741	0.000	**0.150**
2 MONTH	Coefficient	3.372	0.000	**5.030**	2.646	1.505	-0.358	**4.310**
	P-value	0.000	0.893	**0.022**	0.056	0.339	0.000	**0.101**
3 MONTH	Coefficient	3.252	0.000	**7.310**	3.151	1.755	-0.360	**5.083**
	P-value	0.000	0.652	**0.003**	0.019	0.264	0.000	**0.119**
4 MONTH	Coefficient	3.193	0.001	**8.205**	3.552	1.439	-0.362	**5.653**
	P-value	0.000	0.540	**0.026**	0.009	0.335	0.000	**0.234**
5 MONTH	Coefficient	3.171	0.001	**7.923**	3.885	0.863	-0.366	**6.659**
	P-value	0.000	0.526	**0.072**	0.008	0.560	0.000	**0.240**
6 MONTH	Coefficient	3.075	0.001	**8.960**	4.609	0.289	-0.370	**7.375**
	P-value	0.000	0.423	**0.051**	0.002	0.847	0.000	**0.208**
9 MONTH	Coefficient	3.073	0.001	**9.464**	4.823	-0.533	-0.373	**7.590**
	P-value	0.000	0.376	**0.089**	0.001	0.727	0.000	**0.270**
12 MONTH	Coefficient	2.948	0.001	**13.406**	5.271	-0.489	-0.371	**6.882**
	P-value	0.000	0.185	**0.021**	0.001	0.750	0.000	**0.334**

Table 1.7 does not provide direct measure of how option trading on small firms being affected by past returns. Also, one may argue that the coefficients on other control variables are not allowed to change in the previous setting. To address these issues, I run the regression independently for small firms and for big firms, and the results are presented in Table 1.8. The coefficients on *lret* are statistically significant in all regressions, both for small and for big firms. While the coefficient inflates substantially along with the length of lagged market return for large firms, it stays flat for small firms with lag length longer than three months. This simply suggests only the market return in past three months, at most, influence option trading activities for small firms. Table 1.9 follows Table 1.7 to investigate the impacts of firm size, but looks at the call and put option trading activities independently. Panel A describes the results for call options, and

Panel B summarizes those for put options. In Panel A, the results still suggest no significant difference between large and small firms. However, Panel B does provide evidence showing higher trading turnover on put options for smaller firms in bull market (or lower turnover in bear market). The difference can be explained by small firm investors are less cautious about market volatility and therefore are less involved in hedging activities.

Table 1-8 Companies are sorted by size (separate regressions-Full Sample)

Panel A: Big Firms		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	2.974	0.000	**4.003**	3.760	5.683
	P-value	0.000	0.750	**0.019**	0.072	0.012
2 MONTH	Coefficient	2.756	0.001	**7.890**	4.519	6.962
	P-value	0.000	0.582	**0.000**	0.031	0.007
3 MONTH	Coefficient	2.602	0.001	**11.276**	5.110	7.440
	P-value	0.000	0.413	**0.000**	0.010	0.006
4 MONTH	Coefficient	2.514	0.001	**13.054**	5.617	7.236
	P-value	0.000	0.330	**0.001**	0.005	0.002
5 MONTH	Coefficient	2.475	0.001	**13.535**	6.041	6.621
	P-value	0.000	0.322	**0.005**	0.006	0.005
6 MONTH	Coefficient	2.351	0.001	**15.341**	6.935	5.961
	P-value	0.000	0.257	**0.001**	0.002	0.014
9 MONTH	Coefficient	2.239	0.002	**18.330**	7.615	5.318
	P-value	0.000	0.173	**0.002**	0.001	0.024
12 MONTH	Coefficient	2.017	0.002	**24.445**	8.435	5.524
	P-value	0.000	0.059	**0.000**	0.000	0.014
Panel B: Small Firms		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	3.793	-0.001	**3.778**	0.099	-4.604
	P-value	0.000	0.576	**0.009**	0.954	0.045
2 MONTH	Coefficient	3.631	-0.001	**6.480**	0.774	-3.952
	P-value	0.000	0.697	**0.000**	0.627	0.039
3 MONTH	Coefficient	3.542	0.000	**8.427**	1.191	-3.930
	P-value	0.000	0.835	**0.000**	0.430	0.030
4 MONTH	Coefficient	3.510	0.000	**9.009**	1.488	-4.357
	P-value	0.000	0.887	**0.006**	0.334	0.025

Table 1-8—*Continued*

5 MONTH	Coefficient	3.501	0.000	**8.970**	1.730	-4.896
	P-value	0.000	0.893	**0.026**	0.320	0.012
6 MONTH	Coefficient	3.430	0.000	**9.954**	2.283	-5.383
	P-value	0.000	0.962	**0.011**	0.202	0.004
9 MONTH	Coefficient	3.533	0.000	**8.188**	2.031	-6.383
	P-value	0.000	0.884	**0.101**	0.275	0.002
12 MONTH	Coefficient	3.509	0.000	**9.249**	2.107	-6.503
	P-value	0.000	0.976	**0.092**	0.253	0.002

Table 1-9 OLS regression on call and put turnover rate (size subsamples)

Panel A: Call		*Intercept*	*trend*	***lret***	*disp*	*misg*	D_{size}	$\boldsymbol{D_{size}}$***lret***
1 MONTH	Coefficient	3.818	0.002	**4.510**	2.248	-3.817	-0.358	**1.893**
	P-value	0.000	0.133	**0.017**	0.170	0.039	0.001	**0.396**
2 MONTH	Coefficient	3.561	0.002	**8.480**	3.246	-2.564	-0.361	**2.846**
	P-value	0.000	0.061	**0.001**	0.040	0.128	0.000	**0.334**
3 MONTH	Coefficient	3.402	0.002	**11.919**	3.926	-2.300	-0.361	**2.949**
	P-value	0.000	0.025	**0.000**	0.010	0.166	0.000	**0.388**
4 MONTH	Coefficient	3.305	0.002	**13.631**	4.509	-2.605	-0.362	**3.409**
	P-value	0.000	0.013	**0.001**	0.004	0.109	0.001	**0.495**
5 MONTH	Coefficient	3.248	0.003	**13.797**	5.051	-3.229	-0.369	**4.841**
	P-value	0.000	0.012	**0.005**	0.003	0.048	0.001	**0.433**
6 MONTH	Coefficient	3.105	0.003	**15.351**	6.111	-4.035	-0.374	**5.941**
	P-value	0.000	0.006	**0.002**	0.000	0.013	0.001	**0.352**
9 MONTH	Coefficient	3.021	0.003	**17.598**	6.737	-4.958	-0.378	**6.599**
	P-value	0.000	0.003	**0.004**	0.000	0.004	0.001	**0.385**
12 MONTH	Coefficient	2.842	0.004	**22.996**	7.385	-4.932	-0.379	**6.442**
	P-value	0.000	0.000	**0.000**	0.000	0.005	0.001	**0.404**
Panel B: Put		*Intercept*	*trend*	***lret***	*disp*	*misg*	D_{size}	$\boldsymbol{D_{size}}$***lret***
1 MONTH	Coefficient	3.113	-0.001	**-0.625**	1.315	6.615	-0.400	**4.106**
	P-value	0.000	0.125	**0.678**	0.297	0.000	0.000	**0.038**
2 MONTH	Coefficient	3.038	-0.001	**-0.150**	1.586	7.072	-0.407	**5.929**
	P-value	0.000	0.154	**0.941**	0.194	0.000	0.000	**0.023**

Table 1-9—*Continued*

3 MONTH	Coefficient	2.982	-0.001	**0.280**	1.803	7.279	-0.412	**7.651**
	P-value	0.000	0.202	**0.913**	0.134	0.000	0.000	**0.024**
4 MONTH	Coefficient	2.979	-0.001	**-0.005**	1.922	6.984	-0.414	**8.314**
	P-value	0.000	0.204	**0.999**	0.111	0.000	0.000	**0.072**
5 MONTH	Coefficient	3.014	-0.001	**-0.978**	1.922	6.484	-0.416	**8.601**
	P-value	0.000	0.183	**0.804**	0.123	0.000	0.000	**0.097**
6 MONTH	Coefficient	2.993	-0.001	**-0.800**	2.107	6.278	-0.417	**8.752**
	P-value	0.000	0.191	**0.849**	0.097	0.000	0.000	**0.105**
9 MONTH	Coefficient	3.123	-0.001	**-3.229**	1.654	5.613	-0.418	**8.464**
	P-value	0.000	0.125	**0.517**	0.217	0.001	0.000	**0.174**
12 MONTH	Coefficient	2.842	0.004	**22.996**	7.385	-4.932	-0.379	**6.442**
	P-value	0.000	0.000	**0.000**	0.000	0.005	0.001	**0.404**

In Table 1.10, the dependent variable in Panel A and B is call option turnover, while that is put option turnover in Panel C and D. Therefore, the results in Panel A and B are comparable with Panel A in Table 1.9. In Panel A and B, we observe the similar pattern as that the *lret* term is positive statistically significant at 1% level across all regressions. However, the same with Table 1.8, the results are not consistent with my hypothesis (H4) that smaller firms are more likely subject to investor overconfidence. While this could be potentially the evidence to that the options market to small firms is more efficient, this argument contradicts to our intuition. It is worth noting that the coefficients on *misg* are all negative and statistically significant in Panel B, while they are not statistically significant in Panel A. This might be crucial for the differences observed between the two panels. As mentioned above, *misg* accounts for market volatility, we may find it logical to attribute the negative and statistically significant coefficients on *misg* to the fear of trading in volatile days. In the recent financial crisis since year of 2008, we have seen extreme activities in terms of trading and pricing. One may wonder whether

some of the findings above are driven by the extreme cases happening during the crisis. Table 1.11 and 1.12 address this issue by looking at only observations before 2008.

Table 1-10 OLS regression on call and put turnover rate (size subsample)

Panel A: Call - Large		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	3.187	0.002	**6.132**	4.223	1.398
	P-value	0.000	0.117	**0.002**	0.086	0.522
2 MONTH	Coefficient	2.878	0.003	**11.523**	5.361	3.033
	P-value	0.000	0.057	**0.000**	0.028	0.187
3 MONTH	Coefficient	2.663	0.003	**16.271**	6.209	3.644
	P-value	0.000	0.024	**0.000**	0.007	0.131
4 MONTH	Coefficient	2.528	0.003	**18.986**	6.957	3.404
	P-value	0.000	0.014	**0.000**	0.003	0.099
5 MONTH	Coefficient	2.460	0.004	**19.934**	7.608	2.588
	P-value	0.000	0.014	**0.000**	0.004	0.219
6 MONTH	Coefficient	2.291	0.004	**22.330**	8.876	1.554
	P-value	0.000	0.009	**0.000**	0.001	0.474
9 MONTH	Coefficient	2.103	0.004	**27.197**	9.963	0.700
	P-value	0.000	0.003	**0.000**	0.000	0.760
12 MONTH	Coefficient	1.843	0.005	**34.702**	10.907	0.807
	P-value	0.000	0.000	**0.000**	0.000	0.713
Panel B: Call - Small		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	4.091	0.001	**4.781**	0.273	-9.032
	P-value	0.000	0.583	**0.003**	0.883	0.002
2 MONTH	Coefficient	3.882	0.001	**8.282**	1.131	-8.160
	P-value	0.000	0.451	**0.000**	0.509	0.001
3 MONTH	Coefficient	3.781	0.001	**10.517**	1.643	-8.244
	P-value	0.000	0.345	**0.000**	0.304	0.000
4 MONTH	Coefficient	3.720	0.001	**11.686**	2.062	-8.615
	P-value	0.000	0.288	**0.001**	0.213	0.001
5 MONTH	Coefficient	3.667	0.002	**12.500**	2.495	-9.046
	P-value	0.000	0.270	**0.005**	0.195	0.000
6 MONTH	Coefficient	3.546	0.002	**14.313**	3.346	-9.623
	P-value	0.000	0.215	**0.001**	0.091	0.000

Table 1-10—*Continued*

9 MONTH	Coefficient	3.561	0.002	**14.599**	3.512	-10.616
	P-value	0.000	0.213	**0.011**	0.088	0.000
12 MONTH	Coefficient	3.461	0.002	**17.732**	3.863	-10.672
	P-value	0.000	0.131	**0.004**	0.053	0.000
Panel C: Put - Large		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	2.610	-0.001	**0.716**	3.141	11.110
	P-value	0.000	0.299	**0.637**	0.062	0.000
2 MONTH	Coefficient	2.532	-0.001	**2.285**	3.314	11.840
	P-value	0.000	0.338	**0.275**	0.053	0.000
3 MONTH	Coefficient	2.477	-0.001	**3.482**	3.503	12.075
	P-value	0.000	0.384	**0.184**	0.035	0.000
4 MONTH	Coefficient	2.456	-0.001	**3.901**	3.645	11.963
	P-value	0.000	0.401	**0.286**	0.029	0.000
5 MONTH	Coefficient	2.461	-0.001	**3.689**	3.723	11.670
	P-value	0.000	0.397	**0.377**	0.028	0.000
6 MONTH	Coefficient	2.407	-0.001	**4.596**	4.041	11.585
	P-value	0.000	0.438	**0.288**	0.019	0.000
9 MONTH	Coefficient	2.425	-0.001	**4.406**	4.042	11.222
	P-value	0.000	0.445	**0.406**	0.024	0.000
12 MONTH	Coefficient	2.283	-0.001	**7.846**	4.582	11.521
	P-value	0.000	0.625	**0.169**	0.010	0.000
Panel D: Put - Small		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	3.215	-0.001	**2.140**	-0.511	2.121
	P-value	0.000	0.260	**0.143**	0.763	0.331
2 MONTH	Coefficient	3.138	-0.001	**3.345**	-0.143	2.304
	P-value	0.000	0.295	**0.075**	0.931	0.267
3 MONTH	Coefficient	3.075	-0.001	**4.727**	0.104	2.483
	P-value	0.000	0.355	**0.045**	0.949	0.223
4 MONTH	Coefficient	3.087	-0.001	**4.404**	0.199	2.004
	P-value	0.000	0.340	**0.178**	0.903	0.324
5 MONTH	Coefficient	3.150	-0.001	**2.956**	0.121	1.298
	P-value	0.000	0.298	**0.420**	0.944	0.495
6 MONTH	Coefficient	3.162	-0.001	**2.556**	0.174	0.971
	P-value	0.000	0.278	**0.480**	0.921	0.604

Table 1-10—*Continued*

9 MONTH	Coefficient	3.404	-0.002	**-2.401**	-0.734	0.005
	P-value	0.000	0.149	**0.594**	0.687	0.998
12 MONTH	Coefficient	3.521	-0.002	**-5.162**	-1.182	-0.270
	P-value	0.000	0.109	**0.315**	0.533	0.890

Table 1-11 OLS regression on turnover rate (size subsample - before 2008)

Panel A: TO_O		*Intercept*	*trend*	***Iret***	*disp*	*MAD*	D_{size}	$\boldsymbol{D_{size}}$***Iret***
1 MONTH	Coefficient	4.833	-0.008	**0.982**	-3.267	-3.286	-0.151	**3.304**
	P-value	0.000	0.000	**0.463**	0.029	0.177	0.096	**0.089**
2 MONTH	Coefficient	4.690	-0.008	**2.906**	-2.893	-2.237	-0.156	**4.032**
	P-value	0.000	0.000	**0.201**	0.059	0.373	0.082	**0.191**
3 MONTH	Coefficient	4.427	-0.007	**7.966**	-2.365	-0.136	-0.154	**3.822**
	P-value	0.000	0.000	**0.003**	0.118	0.957	0.080	**0.293**
4 MONTH	Coefficient	4.266	-0.007	**10.931**	-1.478	-0.462	-0.150	**3.286**
	P-value	0.000	0.000	**0.001**	0.339	0.848	0.084	**0.444**
5 MONTH	Coefficient	4.228	-0.006	**12.478**	-1.149	-1.053	-0.145	**2.534**
	P-value	0.000	0.000	**0.000**	0.457	0.663	0.101	**0.592**
6 MONTH	Coefficient	4.193	-0.006	**14.027**	-1.016	-1.197	-0.143	**2.282**
	P-value	0.000	0.000	**0.000**	0.511	0.632	0.115	**0.657**
9 MONTH	Coefficient	4.171	-0.006	**17.439**	-0.815	-2.075	-0.111	**-2.398**
	P-value	0.000	0.000	**0.000**	0.611	0.384	0.222	**0.671**
12 MONTH	Coefficient	4.090	-0.006	**20.439**	-0.651	-1.903	-0.088	**-5.479**
	P-value	0.000	0.000	**0.000**	0.684	0.438	0.361	**0.376**
Panel B: TO_C		*Intercept*	*trend*	***Iret***	*disp*	*MAD*	D_{size}	$\boldsymbol{D_{size}}$***Iret***
1 MONTH	Coefficient	5.158	-0.007	**2.794**	-2.894	-8.613	-0.138	**2.513**
	P-value	0.000	0.000	**0.071**	0.074	0.002	0.190	**0.252**
2 MONTH	Coefficient	4.936	-0.007	**6.228**	-2.319	-7.024	-0.138	**2.608**
	P-value	0.000	0.000	**0.021**	0.161	0.013	0.184	**0.463**
3 MONTH	Coefficient	4.621	-0.006	**12.901**	-1.642	-4.701	-0.128	**1.086**
	P-value	0.000	0.000	**0.000**	0.307	0.105	0.207	**0.789**
4 MONTH	Coefficient	4.412	-0.005	**17.027**	-0.464	-5.232	-0.118	**-0.269**
	P-value	0.000	0.000	**0.000**	0.778	0.056	0.234	**0.955**
5 MONTH	Coefficient	4.319	-0.005	**19.810**	0.093	-5.772	-0.113	**-1.093**
	P-value	0.000	0.001	**0.000**	0.954	0.038	0.262	**0.839**

Table 1-11—*Continued*

6 MONTH	Coefficient	4.256	-0.005	**22.183**	0.323	-5.891	-0.112	**-1.237**
	P-value	0.000	0.002	**0.000**	0.844	0.040	0.283	**0.831**
9 MONTH	Coefficient	4.167	-0.004	**27.697**	0.792	-6.875	-0.074	**-6.649**
	P-value	0.000	0.005	**0.000**	0.638	0.012	0.474	**0.292**
12 MONTH	Coefficient	4.022	-0.004	**31.780**	1.126	-6.492	-0.054	**-9.170**
	P-value	0.000	0.016	**0.000**	0.507	0.021	0.615	**0.167**
Panel C: TO_P		*Intercept*	*trend*	***Iret***	*disp*	*MAD*	D_{size}	$\boldsymbol{D_{size}}$***Iret***
1 MONTH	Coefficient	4.224	-0.008	**-1.802**	-4.213	5.532	-0.235	**4.291**
	P-value	0.000	0.000	**0.172**	0.009	0.026	0.008	**0.031**
2 MONTH	Coefficient	4.212	-0.008	**-2.244**	-4.166	5.642	-0.244	**5.690**
	P-value	0.000	0.000	**0.269**	0.009	0.029	0.006	**0.061**
3 MONTH	Coefficient	4.036	-0.007	**0.206**	-3.889	7.355	-0.256	**7.459**
	P-value	0.000	0.000	**0.934**	0.016	0.004	0.004	**0.035**
4 MONTH	Coefficient	3.951	-0.007	**1.412**	-3.480	7.392	-0.260	**8.043**
	P-value	0.000	0.000	**0.645**	0.034	0.003	0.004	**0.056**
5 MONTH	Coefficient	3.994	-0.007	**1.199**	-3.503	6.773	-0.253	**7.186**
	P-value	0.000	0.000	**0.711**	0.041	0.007	0.005	**0.104**
6 MONTH	Coefficient	3.991	-0.007	**1.754**	-3.486	6.666	-0.250	**6.656**
	P-value	0.000	0.000	**0.623**	0.040	0.008	0.007	**0.182**
9 MONTH	Coefficient	4.069	-0.007	**2.008**	-3.693	5.977	-0.226	**3.017**
	P-value	0.000	0.000	**0.607**	0.037	0.013	0.016	**0.595**
12 MONTH	Coefficient	4.117	-0.007	**2.955**	-3.891	5.685	-0.193	**-1.570**
	P-value	0.000	0.000	**0.535**	0.030	0.022	0.052	**0.809**

Generally speaking, the results are not much different from the ones in Table 1.7 through 1.10. To have another look at the size effect in this issue, I then sort the stock into quartiles and run the regressions with dummies[7] and interaction terms. The results are presented in Table 1.13. The portfolio with *S1* = 1 exhibits the strongest relationship between trading turnover and past market returns, while the others show virtually no

[7] The dummies are *S1*, *S2*, S3, and *S4*, where *S1* = 1 for the portfolio comprised of firms whose market capitalization is among the lowest 25% of all NYSE listed firms, *S2* = 1 for the portfolio comprised of firms whose size is in between 25% to 50% of all NYSE listed firms, and so forth. *S4* is dropped from regression to make solution matrix full rank.

pattern. This finding supports H4 but only for the smallest size quartile. In sum, there is little evidence showing smaller firms are more likely subject to investor overconfidence. The findings in Table 1.13 suggest the relationship may exist, but further investigation is needed.

Table 1-12 OLS regression on turnover rate (size subsample – before 2008)

Panel A: TO_O (Big)		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	4.694	-0.012	**1.498**	-2.026	1.185
	P-value	0.000	0.000	**0.239**	0.322	0.656
2 MONTH	Coefficient	4.544	-0.011	**3.991**	-1.755	2.549
	P-value	0.000	0.000	**0.076**	0.425	0.378
3 MONTH	Coefficient	4.244	-0.010	**9.597**	-1.203	5.100
	P-value	0.000	0.000	**0.000**	0.581	0.085
4 MONTH	Coefficient	4.061	-0.010	**12.730**	-0.275	4.985
	P-value	0.000	0.000	**0.000**	0.900	0.063
5 MONTH	Coefficient	3.997	-0.010	**14.442**	0.135	4.554
	P-value	0.000	0.000	**0.000**	0.945	0.086
6 MONTH	Coefficient	3.964	-0.009	**15.897**	0.269	4.390
	P-value	0.000	0.000	**0.000**	0.891	0.127
9 MONTH	Coefficient	3.819	-0.009	**19.912**	0.892	4.064
	P-value	0.000	0.000	**0.000**	0.643	0.147
12 MONTH	Coefficient	3.634	-0.008	**23.777**	1.385	4.685
	P-value	0.000	0.000	**0.000**	0.448	0.080
Panel A: TO_O (Small)		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	4.822	-0.005	**3.769**	-4.508	-7.757
	P-value	0.000	0.019	**0.017**	0.026	0.023
2 MONTH	Coefficient	4.681	-0.004	**5.853**	-4.030	-7.023
	P-value	0.000	0.036	**0.032**	0.053	0.042
3 MONTH	Coefficient	4.456	-0.004	**10.157**	-3.526	-5.372
	P-value	0.000	0.083	**0.003**	0.081	0.130
4 MONTH	Coefficient	4.321	-0.003	**12.418**	-2.682	-5.909
	P-value	0.000	0.108	**0.002**	0.200	0.078
5 MONTH	Coefficient	4.314	-0.003	**13.047**	-2.433	-6.659
	P-value	0.000	0.117	**0.007**	0.266	0.054

Table 1-12—*Continued*

6 MONTH	Coefficient	4.280	-0.003	**14.439**	-2.301	-6.785
	P-value	0.000	0.127	**0.004**	0.290	0.055
9 MONTH	Coefficient	4.412	-0.004	**12.568**	-2.522	-8.214
	P-value	0.000	0.094	**0.020**	0.272	0.013
12 MONTH	Coefficient	4.457	-0.004	**11.623**	-2.686	-8.492
	P-value	0.000	0.079	**0.030**	0.226	0.015
Panel C: TO_C (Big)		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	5.091	-0.011	**3.276**	-2.094	-4.101
	P-value	0.000	0.000	**0.034**	0.320	0.176
2 MONTH	Coefficient	4.846	-0.010	**7.254**	-1.573	-2.066
	P-value	0.000	0.000	**0.008**	0.499	0.514
3 MONTH	Coefficient	4.455	-0.009	**14.631**	-0.789	1.069
	P-value	0.000	0.000	**0.000**	0.724	0.743
4 MONTH	Coefficient	4.201	-0.008	**18.972**	0.569	0.722
	P-value	0.000	0.000	**0.000**	0.801	0.800
5 MONTH	Coefficient	4.087	-0.008	**21.859**	1.228	0.186
	P-value	0.000	0.000	**0.000**	0.525	0.947
6 MONTH	Coefficient	4.038	-0.008	**24.043**	1.428	-0.067
	P-value	0.000	0.000	**0.000**	0.467	0.983
9 MONTH	Coefficient	3.813	-0.007	**30.239**	2.389	-0.535
	P-value	0.000	0.000	**0.000**	0.205	0.858
12 MONTH	Coefficient	3.584	-0.006	**35.027**	2.985	0.194
	P-value	0.000	0.000	**0.000**	0.090	0.947
Panel D: TO_C (Small)		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	5.087	-0.004	**4.825**	-3.693	-13.125
	P-value	0.000	0.133	**0.010**	0.128	0.002
2 MONTH	Coefficient	4.888	-0.003	**7.809**	-3.066	-11.981
	P-value	0.000	0.207	**0.009**	0.205	0.004
3 MONTH	Coefficient	4.659	-0.002	**12.257**	-2.494	-10.470
	P-value	0.000	0.339	**0.001**	0.287	0.017
4 MONTH	Coefficient	4.506	-0.002	**14.814**	-1.498	-11.186
	P-value	0.000	0.422	**0.001**	0.534	0.007
5 MONTH	Coefficient	4.438	-0.002	**16.668**	-1.041	-11.731
	P-value	0.000	0.486	**0.004**	0.679	0.007

Table 1-12—*Continued*

6 MONTH	Coefficient	4.363	-0.001	**19.086**	-0.783	-11.715
	P-value	0.000	0.559	**0.002**	0.755	0.008
9 MONTH	Coefficient	4.447	-0.002	**18.505**	-0.806	-13.215
	P-value	0.000	0.518	**0.004**	0.761	0.001
12 MONTH	Coefficient	4.406	-0.001	**19.364**	-0.732	-13.178
	P-value	0.000	0.585	**0.003**	0.784	0.002
Panel E: TO_P (Big)		*Intercept*	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	4.028	-0.011	**-1.450**	-2.111	8.799
	P-value	0.000	0.000	**0.214**	0.340	0.004
2 MONTH	Coefficient	4.036	-0.011	**-1.425**	-2.254	9.050
	P-value	0.000	0.000	**0.450**	0.306	0.005
3 MONTH	Coefficient	3.890	-0.011	**1.178**	-2.093	10.596
	P-value	0.000	0.000	**0.603**	0.359	0.001
4 MONTH	Coefficient	3.817	-0.011	**2.472**	-1.859	10.940
	P-value	0.000	0.000	**0.362**	0.416	0.001
5 MONTH	Coefficient	3.821	-0.011	**2.496**	-1.824	10.758
	P-value	0.000	0.000	**0.431**	0.430	0.001
6 MONTH	Coefficient	3.799	-0.010	**3.073**	-1.755	10.820
	P-value	0.000	0.000	**0.382**	0.446	0.001
9 MONTH	Coefficient	3.776	-0.010	**3.747**	-1.650	10.736
	P-value	0.000	0.000	**0.332**	0.484	0.001
12 MONTH	Coefficient	3.675	-0.010	**5.871**	-1.361	11.130
	P-value	0.000	0.000	**0.211**	0.573	0.000
Panel F: TO_P (Small)		*Intercept*	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	4.185	-0.004	**2.138**	-6.314	2.265
	P-value	0.000	0.032	**0.165**	0.001	0.479
2 MONTH	Coefficient	4.144	-0.004	**2.626**	-6.077	2.235
	P-value	0.000	0.046	**0.356**	0.002	0.506
3 MONTH	Coefficient	3.926	-0.003	**6.693**	-5.685	4.115
	P-value	0.000	0.110	**0.050**	0.004	0.227
4 MONTH	Coefficient	3.825	-0.003	**8.395**	-5.101	3.844
	P-value	0.000	0.130	**0.031**	0.014	0.245
5 MONTH	Coefficient	3.913	-0.003	**7.087**	-5.182	2.789
	P-value	0.000	0.110	**0.105**	0.017	0.381

Table 1-12—*Continued*

6 MONTH	Coefficient	3.933	-0.003	**7.090**	-5.216	2.511
	P-value	0.000	0.089	**0.106**	0.011	0.437
9 MONTH	Coefficient	4.136	-0.004	**3.287**	-5.737	1.217
	P-value	0.000	0.049	**0.522**	0.007	0.692
12 MONTH	Coefficient	4.366	-0.005	**-1.532**	-6.421	0.240
	P-value	0.000	0.020	**0.776**	0.001	0.941

1.4.2.2.2. Sample sorted into portfolios based on BE/ME ratio. In this subsection, I adopt the same methodology as the previous subsection but sort firms into portfolios according to their book-to-market ratio. Table 1.14 has similar sense to Table 1.7, 1.9, and 1.13. Similar those tables, Table 1.14 show little, if any, difference among three book-to-market portfolios. None of the interaction terms is statistically significant, and there are positives and negatives across regressions. Therefore, I again run independent regressions for each of the three portfolios. The results are shown in Table 1.15 and 1.16. While Table 1.15 generally agrees with Table 1.14, we could observe some difference in Table 1.16. The coefficients on lret are larger in magnitude in Panel B than the corresponding ones in Panel A, which may suggest trading activities with low BE/ME ratio firms are more likely affected by past market returns. These low BE/ME ratio firms are commonly referred as “growth” or “glamour”, as the market value the firms more per dollar of book value. From one perspective, investors on growth or glamour firms are more likely subject to overconfidence, because they receive more attention from the market and even those investors who do not have much knowledge about the market may have heard of those companies. From a different perspective, one may argue growth or glamour firms are received more attention, and therefore there is more information available in the market about them. Thus, there would be little room for overconfidence to take place.

Table 1-13 OLS regression on turnover rate, where companies are sorted by size (Full Sample)

Panel A: Call + Put		*Intercept*	*trend*	***lret***	*disp*	*MAD*	***S1*lret***	***S2*lret***	***S3*lret***
1 MONTH	Coefficient	4.085	0.000	**0.936**	-0.059	-3.923	**5.887**	**2.275**	**1.433**
	P-value	0.000	0.943	**0.625**	0.960	0.020	**0.048**	**0.316**	**0.497**
2 MONTH	Coefficient	3.941	0.000	**2.200**	0.543	-3.270	**8.672**	**3.401**	**2.547**
	P-value	0.000	0.762	**0.388**	0.629	0.053	**0.024**	**0.265**	**0.389**
3 MONTH	Coefficient	3.805	0.001	**3.718**	1.031	-2.650	**14.463**	**3.171**	**3.349**
	P-value	0.000	0.515	**0.201**	0.341	0.101	**0.002**	**0.387**	**0.331**
4 MONTH	Coefficient	3.715	0.001	**4.069**	1.496	-2.604	**19.271**	**3.035**	**5.197**
	P-value	0.000	0.373	**0.315**	0.160	0.095	**0.001**	**0.552**	**0.265**
5 MONTH	Coefficient	3.678	0.001	**3.171**	1.886	-3.041	**22.794**	**3.751**	**7.168**
	P-value	0.000	0.338	**0.515**	0.091	0.052	**0.001**	**0.540**	**0.205**
6 MONTH	Coefficient	3.593	0.001	**3.500**	2.591	-3.685	**24.462**	**4.395**	**8.390**
	P-value	0.000	0.265	**0.507**	0.024	0.020	**0.001**	**0.496**	**0.171**
9 MONTH	Coefficient	3.614	0.001	**2.456**	2.741	-4.573	**26.940**	**4.570**	**10.951**
	P-value	0.000	0.247	**0.691**	0.022	0.003	**0.002**	**0.542**	**0.136**
12 MONTH	Coefficient	3.502	0.001	**5.466**	3.161	-4.546	**27.972**	**3.500**	**12.599**
	P-value	0.000	0.109	**0.391**	0.010	0.005	**0.002**	**0.652**	**0.107**

Table 1-13—*Continued*

Panel B: Call		*Intercept*	*trend*	***lret***	*disp*	*MAD*	***S1*lret***	***S2*lret***	***S3*lret***
1 MONTH	Coefficient	4.391	0.002	**2.940**	0.100	-8.883	**5.612**	**1.120**	**0.412**
	P-value	0.000	0.079	**0.175**	0.941	0.000	**0.119**	**0.658**	**0.866**
2 MONTH	Coefficient	4.179	0.002	**5.540**	0.957	-7.892	**8.962**	**1.615**	**0.907**
	P-value	0.000	0.041	**0.055**	0.461	0.000	**0.044**	**0.638**	**0.791**
3 MONTH	Coefficient	4.013	0.002	**8.124**	1.598	-7.325	**13.864**	**0.840**	**1.400**
	P-value	0.000	0.016	**0.009**	0.202	0.000	**0.011**	**0.826**	**0.708**
4 MONTH	Coefficient	3.891	0.003	**9.196**	2.222	-7.284	**18.362**	**0.696**	**3.250**
	P-value	0.000	0.007	**0.036**	0.076	0.000	**0.004**	**0.897**	**0.522**
5 MONTH	Coefficient	3.831	0.003	**8.567**	2.769	-7.829	**21.721**	**1.936**	**5.295**
	P-value	0.000	0.006	**0.115**	0.038	0.000	**0.004**	**0.773**	**0.404**
6 MONTH	Coefficient	3.714	0.003	**9.220**	3.732	-8.703	**23.312**	**3.061**	**6.625**
	P-value	0.000	0.003	**0.119**	0.007	0.000	**0.004**	**0.667**	**0.336**
9 MONTH	Coefficient	3.701	0.003	**9.300**	4.084	-9.790	**24.565**	**3.932**	**8.762**
	P-value	0.000	0.003	**0.182**	0.004	0.000	**0.013**	**0.638**	**0.294**
12 MONTH	Coefficient	3.546	0.004	**13.404**	4.659	-9.768	**25.712**	**3.477**	**10.554**
	P-value	0.000	0.000	**0.062**	0.001	0.000	**0.010**	**0.684**	**0.230**

Table 1-13—*Continued*

Panel C: Put		*Intercept*	*trend*	***lret***	*disp*	*MAD*	***S1*lret***	***S2*lret***	***S3*lret***
1 MONTH	Coefficient	3.580	-0.001	**-2.033**	-0.507	2.882	**6.017**	**3.592**	**2.785**
	P-value	0.000	0.155	**0.230**	0.621	0.065	**0.019**	**0.095**	**0.136**
2 MONTH	Coefficient	3.546	-0.001	**-2.845**	-0.323	2.978	**7.715**	**5.558**	**4.807**
	P-value	0.000	0.173	**0.216**	0.744	0.070	**0.036**	**0.056**	**0.069**
3 MONTH	Coefficient	3.483	-0.001	**-3.177**	-0.130	3.444	**13.581**	**6.028**	**5.959**
	P-value	0.000	0.234	**0.272**	0.892	0.031	**0.002**	**0.113**	**0.076**
4 MONTH	Coefficient	3.453	-0.001	**-3.965**	0.041	3.476	**18.262**	**5.787**	**7.680**
	P-value	0.000	0.269	**0.296**	0.965	0.018	**0.001**	**0.243**	**0.076**
5 MONTH	Coefficient	3.455	-0.001	**-5.343**	0.148	3.240	**21.934**	**5.707**	**9.540**
	P-value	0.000	0.271	**0.215**	0.873	0.027	**0.000**	**0.305**	**0.054**
6 MONTH	Coefficient	3.423	-0.001	**-5.620**	0.408	3.045	**24.041**	**5.628**	**10.702**
	P-value	0.000	0.300	**0.230**	0.665	0.037	**0.000**	**0.339**	**0.048**
9 MONTH	Coefficient	3.535	-0.001	**-9.034**	0.072	2.409	**27.557**	**4.835**	**13.707**
	P-value	0.000	0.217	**0.095**	0.943	0.088	**0.000**	**0.472**	**0.032**
12 MONTH	Coefficient	3.517	-0.001	**-8.384**	0.143	2.407	**28.272**	**2.713**	**14.901**
	P-value	0.000	0.259	**0.145**	0.892	0.091	**0.001**	**0.709**	**0.034**

Table 1.16 may support the overconfidence argument to some extent, in that the coefficients on misg in Panel B are statistically significant and larger in magnitude while those on Panel A are generally not statistically significant. Investors on low BE/ME firms trade more in a more volatile market, which indicates more hedging activities using put options as shown in Panel E in Table 1.16. When turn to Panel B, coefficients on misg turn to insignificant while the ones on lret become larger. This finding fits the argument that investors pay more attention to growth stocks, and therefore trade more frequently, relative to value stocks, in both bull and bear markets. I also redo all analyses with the observations before year of 2008, and summarize the results in Table 1.17. Similar conclusion may be drawn from Table 1.17, but there is a noticeable change in misg coefficients. Compare Panel D in Table 1.16 and Panel G in Table 1.17, the coefficients on misg become statistically significant once observations on and after year 2008 are used. This might suggest investors become more cautious about market risk after a major market downturn, especially for more risky firms. The same phenomenon can be found between Panel F in Table 3.16 and Panel I in Table 3.17. The two panels are for medium BE/ME firms, and therefore may better represent the general cases. As for low BE/ME firms, the difference is negligible. This, again, may serve as an evidence that growth or glamour firms attracts more noisy traders and therefore are more likely subject to psychological biases.

Table 1-14 OLS regression on turnover rate, where companies are sorted by book to market ratio (Full Sample)

Panel A: Call + Put		Intercept	*trend*	***lret***	*disp*	*MAD*	***MBM*lret***	***LBM*lret***
1 MONTH	Coefficient	2.467	0.002	**4.655**	2.902	4.188	**-1.003**	**-1.327**
	P-value	0.000	0.029	**0.004**	0.015	0.001	**0.669**	**0.517**
2 MONTH	Coefficient	2.253	0.002	**8.259**	3.640	5.477	**-0.528**	**-1.052**
	P-value	0.000	0.011	**0.000**	0.003	0.000	**0.865**	**0.700**
3 MONTH	Coefficient	2.098	0.003	**12.206**	4.225	5.974	**-1.388**	**-1.887**
	P-value	0.000	0.003	**0.000**	0.000	0.000	**0.715**	**0.570**
4 MONTH	Coefficient	1.997	0.003	**15.125**	4.747	5.847	**-3.361**	**-2.810**
	P-value	0.000	0.002	**0.000**	0.000	0.000	**0.536**	**0.558**
5 MONTH	Coefficient	1.942	0.003	**16.316**	5.214	5.328	**-4.204**	**-3.162**
	P-value	0.000	0.001	**0.000**	0.000	0.000	**0.518**	**0.579**
6 MONTH	Coefficient	1.806	0.003	**17.911**	6.168	4.701	**-3.732**	**-2.220**
	P-value	0.000	0.001	**0.000**	0.000	0.000	**0.585**	**0.701**
9 MONTH	Coefficient	1.675	0.003	**20.200**	6.953	4.101	**-3.181**	**0.935**
	P-value	0.000	0.000	**0.000**	0.000	0.001	**0.696**	**0.892**
12 MONTH	Coefficient	1.490	0.004	**23.758**	7.660	4.201	**-0.323**	**4.056**
	P-value	0.000	0.000	**0.000**	0.000	0.001	**0.970**	**0.578**

Table 1-14—*Continued*

Panel B: Call		Intercept	*trend*	***lret***	*disp*	*MAD*	***MBM*lret***	***LBM*lret***
1 MONTH	Coefficient	2.766	0.004	**6.643**	3.105	-0.294	**-1.055**	**-1.273**
	P-value	0.000	0.000	**0.000**	0.027	0.834	**0.688**	**0.591**
2 MONTH	Coefficient	2.473	0.004	**11.230**	4.195	1.284	**-0.258**	**-0.286**
	P-value	0.000	0.000	**0.000**	0.003	0.338	**0.941**	**0.929**
3 MONTH	Coefficient	2.257	0.005	**16.727**	5.018	1.927	**-1.551**	**-1.440**
	P-value	0.000	0.000	**0.000**	0.000	0.148	**0.700**	**0.690**
4 MONTH	Coefficient	2.109	0.005	**20.626**	5.774	1.805	**-3.518**	**-2.400**
	P-value	0.000	0.000	**0.000**	0.000	0.156	**0.538**	**0.645**
5 MONTH	Coefficient	2.023	0.005	**22.290**	6.462	1.113	**-4.238**	**-2.814**
	P-value	0.000	0.000	**0.000**	0.000	0.386	**0.550**	**0.660**
6 MONTH	Coefficient	1.847	0.005	**24.016**	7.772	0.131	**-3.085**	**-1.275**
	P-value	0.000	0.000	**0.000**	0.000	0.919	**0.681**	**0.844**
9 MONTH	Coefficient	1.633	0.006	**27.963**	8.992	-0.629	**-2.412**	**2.923**
	P-value	0.000	0.000	**0.000**	0.000	0.658	**0.790**	**0.711**
12 MONTH	Coefficient	1.406	0.007	**32.897**	9.844	-0.608	**0.445**	**6.416**
	P-value	0.000	0.000	**0.000**	0.000	0.662	**0.962**	**0.436**

Table 1-14—*Continued*

Panel C: Put		Intercept	*trend*	***lret***	*disp*	*MAD*	***MBM*lret***	***LBM*lret***
1 MONTH	Coefficient	2.020	0.000	**1.595**	2.467	9.716	**-0.853**	**-1.383**
	P-value	0.000	0.711	**0.274**	0.013	0.000	**0.703**	**0.468**
2 MONTH	Coefficient	1.927	0.000	**3.641**	2.671	10.569	**-0.769**	**-2.091**
	P-value	0.000	0.601	**0.052**	0.008	0.000	**0.796**	**0.401**
3 MONTH	Coefficient	1.869	0.001	**5.076**	2.882	10.787	**-0.912**	**-2.425**
	P-value	0.000	0.497	**0.045**	0.004	0.000	**0.814**	**0.464**
4 MONTH	Coefficient	1.837	0.001	**6.574**	3.053	10.691	**-2.915**	**-3.237**
	P-value	0.000	0.446	**0.058**	0.002	0.000	**0.581**	**0.471**
5 MONTH	Coefficient	1.826	0.001	**7.085**	3.187	10.449	**-3.966**	**-3.502**
	P-value	0.000	0.441	**0.070**	0.002	0.000	**0.507**	**0.486**
6 MONTH	Coefficient	1.753	0.001	**8.365**	3.602	10.367	**-4.344**	**-3.265**
	P-value	0.000	0.362	**0.039**	0.001	0.000	**0.489**	**0.529**
9 MONTH	Coefficient	1.749	0.001	**8.015**	3.716	10.001	**-3.975**	**-1.491**
	P-value	0.000	0.339	**0.099**	0.001	0.000	**0.590**	**0.803**
12 MONTH	Coefficient	1.646	0.001	**9.063**	4.136	10.175	**-1.085**	**1.138**
	P-value	0.000	0.189	**0.097**	0.000	0.000	**0.893**	**0.862**

Table 1-15 OLS regression on turnover rate (BE/ME subsample – full)

Panel A: High BE/ME		Intercept	*trend*	***lret***	*disp*	*Misg*
1 MONTH	Coefficient	2.462	0.001	**3.936**	4.433	1.199
	P-value	0.000	0.443	**0.022**	0.014	0.594
2 MONTH	Coefficient	2.266	0.001	**7.365**	5.162	2.230
	P-value	0.000	0.351	**0.002**	0.005	0.290
3 MONTH	Coefficient	2.083	0.002	**11.403**	5.786	3.067
	P-value	0.000	0.235	**0.000**	0.001	0.157
4 MONTH	Coefficient	1.920	0.002	**14.784**	6.473	3.443
	P-value	0.000	0.155	**0.000**	0.000	0.094
5 MONTH	Coefficient	1.825	0.002	**16.413**	7.102	3.083
	P-value	0.000	0.131	**0.000**	0.000	0.128
6 MONTH	Coefficient	1.686	0.002	**18.380**	8.145	2.230
	P-value	0.000	0.101	**0.000**	0.000	0.269
9 MONTH	Coefficient	1.632	0.003	**20.289**	8.647	1.197
	P-value	0.000	0.083	**0.001**	0.000	0.567
12 MONTH	Coefficient	1.612	0.003	**22.009**	8.677	0.786
	P-value	0.000	0.056	**0.001**	0.000	0.704
Panel B: Low BE/ME		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	3.316	0.001	**3.866**	1.412	7.027
	P-value	0.000	0.336	**0.014**	0.504	0.002
2 MONTH	Coefficient	3.103	0.002	**7.667**	2.146	8.289
	P-value	0.000	0.235	**0.000**	0.301	0.002
3 MONTH	Coefficient	2.972	0.002	**10.549**	2.688	8.572
	P-value	0.000	0.162	**0.000**	0.165	0.002
4 MONTH	Coefficient	2.883	0.002	**12.338**	3.175	8.427
	P-value	0.000	0.127	**0.002**	0.113	0.001
5 MONTH	Coefficient	2.842	0.002	**12.879**	3.588	7.874
	P-value	0.000	0.129	**0.008**	0.105	0.001
6 MONTH	Coefficient	2.704	0.002	**15.025**	4.515	7.343
	P-value	0.000	0.095	**0.002**	0.040	0.003
9 MONTH	Coefficient	2.444	0.003	**21.086**	5.768	7.208
	P-value	0.000	0.035	**0.000**	0.006	0.003
12 MONTH	Coefficient	2.179	0.004	**28.329**	6.747	7.471
	P-value	0.000	0.007	**0.000**	0.000	0.001

Table 1-15—*Continued*

Panel C: Medium BE/ME		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	2.868	0.003	**3.833**	2.860	4.337
	P-value	0.000	0.054	**0.061**	0.320	0.076
2 MONTH	Coefficient	2.632	0.004	**8.165**	3.612	5.911
	P-value	0.000	0.031	**0.002**	0.212	0.028
3 MONTH	Coefficient	2.485	0.004	**11.392**	4.201	6.284
	P-value	0.000	0.019	**0.000**	0.132	0.023
4 MONTH	Coefficient	2.446	0.004	**12.080**	4.592	5.670
	P-value	0.000	0.017	**0.009**	0.105	0.020
5 MONTH	Coefficient	2.422	0.004	**12.289**	4.952	5.028
	P-value	0.000	0.018	**0.031**	0.103	0.040
6 MONTH	Coefficient	2.287	0.004	**14.375**	5.843	4.531
	P-value	0.000	0.012	**0.009**	0.052	0.069
9 MONTH	Coefficient	2.191	0.004	**16.980**	6.444	3.898
	P-value	0.000	0.007	**0.013**	0.030	0.115
12 MONTH	Coefficient	1.895	0.005	**24.668**	7.555	4.345
	P-value	0.000	0.001	**0.000**	0.007	0.071

Table 1-16 OLS regression on call and put option turnover rates (BE/ME subsample)

Panel A: Call - High		Intercept	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	2.938	0.002	**5.447**	4.987	-4.507
	P-value	0.000	0.383	**0.008**	0.034	0.145
2 MONTH	Coefficient	2.699	0.002	**9.466**	5.965	-3.497
	P-value	0.000	0.293	**0.001**	0.012	0.178
3 MONTH	Coefficient	2.458	0.002	**14.782**	6.777	-2.366
	P-value	0.000	0.176	**0.000**	0.003	0.322
4 MONTH	Coefficient	2.260	0.003	**18.883**	7.636	-1.982
	P-value	0.000	0.106	**0.000**	0.001	0.434
5 MONTH	Coefficient	2.149	0.003	**20.754**	8.411	-2.507
	P-value	0.000	0.089	**0.000**	0.001	0.307
6 MONTH	Coefficient	2.015	0.003	**22.401**	9.580	-3.779
	P-value	0.000	0.072	**0.000**	0.000	0.114
9 MONTH	Coefficient	1.947	0.003	**24.746**	10.195	-5.035
	P-value	0.000	0.060	**0.001**	0.000	0.088

Table 1-16—*Continued*

12 MONTH	Coefficient	1.928	0.004	**26.742**	10.213	-5.549
	P-value	0.000	0.039	**0.001**	0.000	0.067
Panel B: Call - Low		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	3.483	0.004	**6.220**	1.300	3.407
	P-value	0.000	0.006	**0.001**	0.609	0.150
2 MONTH	Coefficient	3.157	0.005	**11.989**	2.467	5.238
	P-value	0.000	0.002	**0.000**	0.317	0.062
3 MONTH	Coefficient	2.961	0.005	**16.294**	3.297	5.592
	P-value	0.000	0.001	**0.000**	0.143	0.057
4 MONTH	Coefficient	2.819	0.006	**19.173**	4.063	5.411
	P-value	0.000	0.001	**0.000**	0.089	0.031
5 MONTH	Coefficient	2.746	0.006	**20.211**	4.731	4.612
	P-value	0.000	0.001	**0.001**	0.084	0.064
6 MONTH	Coefficient	2.543	0.006	**23.282**	6.132	3.710
	P-value	0.000	0.001	**0.000**	0.023	0.153
9 MONTH	Coefficient	2.122	0.007	**33.075**	8.149	3.564
	P-value	0.000	0.000	**0.000**	0.001	0.155
12 MONTH	Coefficient	1.775	0.008	**42.902**	9.418	3.783
	P-value	0.000	0.000	**0.000**	0.000	0.103
Panel C: Call - Medium		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	3.062	0.006	**5.933**	3.029	0.217
	P-value	0.000	0.002	**0.009**	0.346	0.931
2 MONTH	Coefficient	2.738	0.006	**11.690**	4.153	2.109
	P-value	0.000	0.001	**0.000**	0.198	0.428
3 MONTH	Coefficient	2.538	0.007	**16.113**	4.981	2.554
	P-value	0.000	0.000	**0.000**	0.108	0.349
4 MONTH	Coefficient	2.445	0.007	**17.905**	5.623	1.987
	P-value	0.000	0.000	**0.000**	0.076	0.403
5 MONTH	Coefficient	2.378	0.007	**18.854**	6.244	1.234
	P-value	0.000	0.000	**0.004**	0.075	0.622
6 MONTH	Coefficient	2.174	0.007	**22.006**	7.603	0.460
	P-value	0.000	0.000	**0.000**	0.029	0.856
9 MONTH	Coefficient	2.000	0.008	**26.581**	8.632	-0.416
	P-value	0.000	0.000	**0.000**	0.010	0.873

Table 1-16—*Continued*

12 MONTH	Coefficient	1.657	0.009	**35.910**	9.902	-0.059
	P-value	0.001	0.000	**0.000**	0.001	0.981
Panel D: Put - High		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	1.799	0.002	**1.396**	3.554	7.911
	P-value	0.000	0.165	**0.358**	0.006	0.009
2 MONTH	Coefficient	1.679	0.002	**3.729**	3.860	8.918
	P-value	0.000	0.132	**0.065**	0.003	0.007
3 MONTH	Coefficient	1.597	0.002	**5.538**	4.157	9.237
	P-value	0.000	0.103	**0.042**	0.001	0.006
4 MONTH	Coefficient	1.490	0.002	**7.801**	4.558	9.648
	P-value	0.000	0.072	**0.032**	0.000	0.002
5 MONTH	Coefficient	1.422	0.003	**9.023**	4.940	9.570
	P-value	0.000	0.061	**0.030**	0.000	0.003
6 MONTH	Coefficient	1.291	0.003	**11.215**	5.713	9.357
	P-value	0.000	0.042	**0.009**	0.000	0.004
9 MONTH	Coefficient	1.276	0.003	**11.999**	5.948	8.667
	P-value	0.000	0.040	**0.023**	0.000	0.003
12 MONTH	Coefficient	1.283	0.003	**12.596**	5.892	8.371
	P-value	0.000	0.033	**0.034**	0.000	0.003
Panel E: Put - Low		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	2.986	-0.002	**0.440**	1.495	11.750
	P-value	0.000	0.113	**0.743**	0.364	0.000
2 MONTH	Coefficient	2.938	-0.002	**1.416**	1.601	12.206
	P-value	0.000	0.127	**0.437**	0.329	0.000
3 MONTH	Coefficient	2.906	-0.002	**2.112**	1.715	12.331
	P-value	0.000	0.144	**0.371**	0.283	0.000
4 MONTH	Coefficient	2.888	-0.002	**2.484**	1.814	12.307
	P-value	0.000	0.155	**0.456**	0.258	0.000
5 MONTH	Coefficient	2.889	-0.002	**2.397**	1.870	12.135
	P-value	0.000	0.157	**0.536**	0.253	0.000
6 MONTH	Coefficient	2.834	-0.001	**3.366**	2.145	12.167
	P-value	0.000	0.182	**0.402**	0.199	0.000
9 MONTH	Coefficient	2.799	-0.001	**4.258**	2.338	12.063
	P-value	0.000	0.219	**0.379**	0.181	0.000

Table 1-16—*Continued*

12 MONTH	Coefficient	2.664	-0.001	**7.525**	2.850	12.345
	P-value	0.000	0.352	**0.156**	0.103	0.000
Panel F: Put - Medium		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	2.555	0.001	**0.713**	2.352	9.488
	P-value	0.000	0.682	**0.717**	0.358	0.002
2 MONTH	Coefficient	2.448	0.001	**2.918**	2.551	10.583
	P-value	0.000	0.619	**0.264**	0.322	0.001
3 MONTH	Coefficient	2.388	0.001	**4.242**	2.776	10.792
	P-value	0.000	0.561	**0.172**	0.271	0.001
4 MONTH	Coefficient	2.429	0.001	**3.286**	2.788	10.117
	P-value	0.000	0.580	**0.456**	0.270	0.001
5 MONTH	Coefficient	2.468	0.001	**2.367**	2.752	9.641
	P-value	0.000	0.609	**0.637**	0.279	0.001
6 MONTH	Coefficient	2.435	0.001	**2.904**	2.948	9.576
	P-value	0.000	0.585	**0.567**	0.244	0.001
9 MONTH	Coefficient	2.469	0.001	**2.322**	2.862	9.274
	P-value	0.000	0.603	**0.715**	0.276	0.001
12 MONTH	Coefficient	2.260	0.001	**7.123**	3.666	9.809
	P-value	0.000	0.428	**0.297**	0.174	0.001

Table 1-17 OLS regression on call and put option turnover rates (BE/ME, 2008)

Panel A: All - High		Intercept	*trend*	***Iret***	*disp*	*Misg*
1 MONTH	Coefficient	4.410	-0.010	**0.780**	-2.302	-5.929
	P-value	0.000	0.000	**0.570**	0.277	0.079
2 MONTH	Coefficient	4.302	-0.010	**2.609**	-2.134	-4.877
	P-value	0.000	0.000	**0.304**	0.339	0.181
3 MONTH	Coefficient	4.034	-0.009	**7.592**	-1.671	-2.506
	P-value	0.000	0.000	**0.021**	0.457	0.499
4 MONTH	Coefficient	3.832	-0.009	**11.100**	-0.801	-2.192
	P-value	0.000	0.001	**0.002**	0.725	0.530
5 MONTH	Coefficient	3.711	-0.008	**13.803**	-0.269	-2.184
	P-value	0.000	0.001	**0.001**	0.898	0.513

Table 1-17—*Continued*

6 MONTH	Coefficient	3.599	-0.008	**16.772**	0.080	-1.902
	P-value	0.000	0.002	**0.000**	0.970	0.582
9 MONTH	Coefficient	3.439	-0.007	**21.180**	0.762	-2.212
	P-value	0.000	0.003	**0.000**	0.711	0.483
12 MONTH	Coefficient	3.450	-0.007	**20.930**	0.674	-2.414
	P-value	0.000	0.004	**0.000**	0.745	0.462
Panel B: All - Low		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	4.704	-0.011	**1.767**	-2.101	2.697
	P-value	0.000	0.000	**0.149**	0.311	0.310
2 MONTH	Coefficient	4.563	-0.010	**4.080**	-1.812	3.903
	P-value	0.000	0.000	**0.065**	0.415	0.192
3 MONTH	Coefficient	4.281	-0.009	**9.348**	-1.284	6.263
	P-value	0.000	0.000	**0.000**	0.558	0.041
4 MONTH	Coefficient	4.108	-0.009	**12.316**	-0.391	6.117
	P-value	0.000	0.000	**0.000**	0.859	0.030
5 MONTH	Coefficient	4.061	-0.009	**13.691**	-0.035	5.612
	P-value	0.000	0.000	**0.000**	0.986	0.045
6 MONTH	Coefficient	4.051	-0.009	**14.640**	0.032	5.337
	P-value	0.000	0.000	**0.000**	0.987	0.078
9 MONTH	Coefficient	3.933	-0.008	**18.023**	0.562	4.972
	P-value	0.000	0.000	**0.000**	0.776	0.090
12 MONTH	Coefficient	3.762	-0.008	**21.608**	1.019	5.552
	P-value	0.000	0.000	**0.000**	0.591	0.046
Panel C: All - Medium		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	5.077	-0.011	**1.303**	-4.611	-2.360
	P-value	0.000	0.000	**0.372**	0.044	0.454
2 MONTH	Coefficient	4.899	-0.011	**4.293**	-4.334	-0.644
	P-value	0.000	0.000	**0.076**	0.077	0.843
3 MONTH	Coefficient	4.576	-0.010	**10.344**	-3.739	2.111
	P-value	0.000	0.000	**0.000**	0.121	0.525
4 MONTH	Coefficient	4.414	-0.009	**13.079**	-2.823	1.734
	P-value	0.000	0.000	**0.000**	0.239	0.564
5 MONTH	Coefficient	4.333	-0.009	**15.114**	-2.362	1.379
	P-value	0.000	0.000	**0.000**	0.284	0.634

Table 1-17—*Continued*

6 MONTH	Coefficient	4.263	-0.009	**17.341**	-2.124	1.403
	P-value	0.000	0.000	**0.000**	0.334	0.643
9 MONTH	Coefficient	4.096	-0.008	**21.912**	-1.416	1.086
	P-value	0.000	0.000	**0.000**	0.512	0.709
12 MONTH	Coefficient	3.900	-0.007	**26.009**	-0.896	1.739
	P-value	0.000	0.001	**0.000**	0.668	0.556
Panel D: Call - High		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	5.213	-0.009	**2.040**	-3.875	-13.017
	P-value	0.000	0.000	**0.226**	0.139	0.001
2 MONTH	Coefficient	5.061	-0.009	**4.514**	-3.551	-11.753
	P-value	0.000	0.001	**0.149**	0.202	0.005
3 MONTH	Coefficient	4.671	-0.007	**11.773**	-2.855	-8.377
	P-value	0.000	0.005	**0.003**	0.303	0.045
4 MONTH	Coefficient	4.402	-0.007	**16.430**	-1.609	-8.199
	P-value	0.000	0.013	**0.000**	0.564	0.033
5 MONTH	Coefficient	4.239	-0.006	**20.125**	-0.866	-8.284
	P-value	0.000	0.023	**0.000**	0.730	0.021
6 MONTH	Coefficient	4.111	-0.006	**23.781**	-0.452	-8.060
	P-value	0.000	0.034	**0.000**	0.858	0.029
9 MONTH	Coefficient	3.822	-0.005	**31.307**	0.698	-8.237
	P-value	0.000	0.075	**0.000**	0.775	0.021
12 MONTH	Coefficient	3.801	-0.004	**31.729**	0.679	-8.379
	P-value	0.000	0.101	**0.000**	0.779	0.022
Panel E: Call - Low		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	5.041	-0.010	**3.580**	-2.074	-1.935
	P-value	0.000	0.000	**0.016**	0.325	0.513
2 MONTH	Coefficient	4.783	-0.009	**7.747**	-1.513	0.172
	P-value	0.000	0.000	**0.004**	0.516	0.958
3 MONTH	Coefficient	4.405	-0.008	**14.919**	-0.731	3.143
	P-value	0.000	0.000	**0.000**	0.742	0.350
4 MONTH	Coefficient	4.170	-0.008	**18.909**	0.597	2.618
	P-value	0.000	0.000	**0.000**	0.792	0.380
5 MONTH	Coefficient	4.087	-0.007	**21.204**	1.169	1.899
	P-value	0.000	0.000	**0.000**	0.545	0.521

Table 1-17—*Continued*

6 MONTH	Coefficient	4.069	-0.007	**22.741**	1.282	1.493
	P-value	0.000	0.000	**0.000**	0.517	0.649
9 MONTH	Coefficient	3.853	-0.006	**28.674**	2.201	1.065
	P-value	0.000	0.000	**0.000**	0.249	0.734
12 MONTH	Coefficient	3.630	-0.005	**33.342**	2.784	1.782
	P-value	0.000	0.001	**0.000**	0.123	0.562
Panel F: Call - Medium		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	5.298	-0.010	**2.976**	-3.770	-7.001
	P-value	0.000	0.000	**0.086**	0.098	0.059
2 MONTH	Coefficient	5.059	-0.010	**6.879**	-3.283	-4.967
	P-value	0.000	0.000	**0.015**	0.183	0.173
3 MONTH	Coefficient	4.679	-0.008	**14.046**	-2.526	-1.903
	P-value	0.000	0.000	**0.000**	0.284	0.604
4 MONTH	Coefficient	4.423	-0.008	**18.421**	-1.195	-2.154
	P-value	0.000	0.000	**0.000**	0.612	0.507
5 MONTH	Coefficient	4.269	-0.007	**22.041**	-0.437	-2.415
	P-value	0.000	0.001	**0.000**	0.834	0.453
6 MONTH	Coefficient	4.178	-0.007	**25.069**	-0.120	-2.441
	P-value	0.000	0.001	**0.000**	0.955	0.462
9 MONTH	Coefficient	3.995	-0.006	**30.443**	0.727	-3.152
	P-value	0.000	0.003	**0.000**	0.727	0.334
12 MONTH	Coefficient	3.772	-0.005	**35.107**	1.305	-2.449
	P-value	0.000	0.011	**0.000**	0.520	0.459
Panel G: Put - High		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	3.158	-0.009	**-1.178**	-0.431	3.802
	P-value	0.000	0.000	**0.394**	0.783	0.317
2 MONTH	Coefficient	3.117	-0.009	**-0.322**	-0.506	4.543
	P-value	0.000	0.000	**0.885**	0.753	0.271
3 MONTH	Coefficient	3.039	-0.008	**1.075**	-0.407	5.325
	P-value	0.000	0.000	**0.723**	0.806	0.195
4 MONTH	Coefficient	2.920	-0.008	**3.198**	-0.070	6.009
	P-value	0.000	0.001	**0.354**	0.968	0.143
5 MONTH	Coefficient	2.834	-0.008	**4.941**	0.223	6.316
	P-value	0.000	0.001	**0.216**	0.896	0.126

Table 1-17—*Continued*

6 MONTH	Coefficient	2.732	-0.007	**7.224**	0.518	6.756
	P-value	0.000	0.002	**0.073**	0.757	0.104
9 MONTH	Coefficient	2.734	-0.007	**7.633**	0.599	6.317
	P-value	0.000	0.002	**0.078**	0.725	0.093
12 MONTH	Coefficient	2.801	-0.007	**6.222**	0.382	5.983
	P-value	0.000	0.001	**0.245**	0.830	0.113
Panel H: Put - Low		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	4.114	-0.010	**-1.263**	-2.257	9.678
	P-value	0.000	0.000	**0.274**	0.327	0.002
2 MONTH	Coefficient	4.163	-0.011	**-1.989**	-2.418	9.414
	P-value	0.000	0.000	**0.279**	0.283	0.004
3 MONTH	Coefficient	4.047	-0.010	**0.062**	-2.316	10.728
	P-value	0.000	0.000	**0.977**	0.320	0.001
4 MONTH	Coefficient	3.971	-0.010	**1.427**	-2.133	11.256
	P-value	0.000	0.000	**0.590**	0.362	0.001
5 MONTH	Coefficient	3.971	-0.010	**1.483**	-2.107	11.165
	P-value	0.000	0.000	**0.634**	0.381	0.001
6 MONTH	Coefficient	3.959	-0.010	**1.798**	-2.070	11.194
	P-value	0.000	0.000	**0.609**	0.388	0.001
9 MONTH	Coefficient	3.987	-0.010	**1.325**	-2.132	10.967
	P-value	0.000	0.000	**0.737**	0.387	0.001
12 MONTH	Coefficient	3.913	-0.010	**2.858**	-1.920	11.261
	P-value	0.000	0.000	**0.543**	0.453	0.000
Panel I: Put - Medium		Intercept	*trend*	***Iret***	*disp*	*misg*
1 MONTH	Coefficient	4.714	-0.012	**-1.472**	-6.217	4.145
	P-value	0.000	0.000	**0.330**	0.021	0.252
2 MONTH	Coefficient	4.650	-0.011	**-0.183**	-6.301	5.213
	P-value	0.000	0.000	**0.939**	0.021	0.179
3 MONTH	Coefficient	4.435	-0.011	**3.735**	-6.002	7.324
	P-value	0.000	0.000	**0.187**	0.031	0.067
4 MONTH	Coefficient	4.428	-0.011	**3.811**	-5.791	6.829
	P-value	0.000	0.000	**0.255**	0.035	0.075
5 MONTH	Coefficient	4.459	-0.011	**3.387**	-5.803	6.404
	P-value	0.000	0.000	**0.359**	0.036	0.091

Table 1-17—*Continued*

6 MONTH	Coefficient	4.413	-0.011	**4.474**	-5.668	6.572
	P-value	0.000	0.000	**0.264**	0.040	0.077
9 MONTH	Coefficient	4.288	-0.010	**7.380**	-5.239	6.845
	P-value	0.000	0.000	**0.098**	0.061	0.054
12 MONTH	Coefficient	4.162	-0.010	**10.003**	-4.889	7.311
	P-value	0.000	0.000	**0.068**	0.086	0.038

1.4.2.2.3. Sample sorted into portfolios based on stock analysts' coverage. The final subsample analysis in this study is based on stock analysts' coverage. As mentioned in above, information could potentially be a factor that influences the effects of investor overconfidence to the market. With a less complete information set, I expect to see a stronger evidence of investor overconfidence. In this study, I use financial analysts' coverage from I/B/E/S database as a proxy for information efficiency. I define that firms with no analyst forecast to next year's earnings as the least efficient group ("None" group), and those with 1 to 3 analysts' forecast as the medium group ("Low" group), and those with more than 3 forecasts as the most efficient group ("High" group). Table 1.18 summarizes all the regressions results. I run separate regressions on option/call/put turnover ratio for each group. Although there is no significant difference between "None" and "Low" group, I do find that "High" group generally has lower coefficients on lret while all coefficients remain positive. On the other hand, the lret coefficients for "None" group are generally higher than the ones for "High" group, which is consistent with our hypothesis that low information efficiency leads to stronger overconfidence. I also would like to point out that the "Low" group is an interesting case. By looking at Panel E, negative misg coefficients suggest less trading activities for the "Low" group when the market is more volatile. If stock analysts do help in reducing information asymmetry, there should not be that much of reduction in trading when the market is volatile. This

may indicate that investors are fear to trade during volatile times, even though there are stock analysts providing professional opinions. Therefore, stock analysts may not help much in mitigating information asymmetry when there are too few of such opinions on the market.

Table 1-18 OLS regression on call and put option turnover rates (coverage subsample)

Panel A: None coverage		*Intercept*	*trend*	***lret***	*disp*	*Misg*
1 MONTH	Coefficient	2.118	0.001	**5.223**	7.204	8.317
	P-value	0.000	0.501	**0.011**	0.003	0.004
2 MONTH	Coefficient	1.876	0.001	**9.356**	8.154	9.446
	P-value	0.000	0.361	**0.000**	0.001	0.005
3 MONTH	Coefficient	1.705	0.002	**13.123**	8.835	9.903
	P-value	0.000	0.232	**0.000**	0.000	0.005
4 MONTH	Coefficient	1.591	0.002	**15.433**	9.451	9.754
	P-value	0.000	0.166	**0.000**	0.000	0.002
5 MONTH	Coefficient	1.533	0.002	**16.251**	9.987	9.105
	P-value	0.000	0.156	**0.001**	0.000	0.003
6 MONTH	Coefficient	1.433	0.002	**17.439**	10.884	8.086
	P-value	0.001	0.130	**0.001**	0.000	0.009
9 MONTH	Coefficient	1.361	0.002	**19.673**	11.439	7.172
	P-value	0.002	0.096	**0.003**	0.000	0.013
12 MONTH	Coefficient	1.144	0.003	**25.760**	12.236	7.333
	P-value	0.008	0.036	**0.000**	0.000	0.009
Panel B: Low coverage		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	3.835	-0.004	**5.855**	0.361	0.767
	P-value	0.000	0.041	**0.003**	0.887	0.777
2 MONTH	Coefficient	3.628	-0.003	**9.062**	1.365	1.214
	P-value	0.000	0.059	**0.000**	0.557	0.629
3 MONTH	Coefficient	3.539	-0.003	**11.005**	1.884	0.900
	P-value	0.000	0.083	**0.000**	0.381	0.711
4 MONTH	Coefficient	3.396	-0.003	**13.967**	2.514	1.152
	P-value	0.000	0.105	**0.000**	0.235	0.634

Table 1-18—*Continued*

5 MONTH	Coefficient	3.290	-0.003	**15.862**	3.157	0.922
	P-value	0.000	0.127	**0.000**	0.170	0.699
6 MONTH	Coefficient	3.167	-0.002	**17.527**	4.123	0.044
	P-value	0.000	0.149	**0.000**	0.084	0.986
9 MONTH	Coefficient	3.073	-0.002	**20.221**	4.765	-0.804
	P-value	0.000	0.196	**0.000**	0.042	0.742
12 MONTH	Coefficient	2.932	-0.002	**24.656**	5.268	-0.869
	P-value	0.000	0.299	**0.000**	0.018	0.722
Panel C: High coverage		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	3.220	0.000	**3.627**	2.690	5.203
	P-value	0.000	0.853	**0.032**	0.197	0.020
2 MONTH	Coefficient	3.016	0.001	**7.290**	3.383	6.443
	P-value	0.000	0.702	**0.001**	0.105	0.011
3 MONTH	Coefficient	2.869	0.001	**10.524**	3.938	6.932
	P-value	0.000	0.538	**0.000**	0.047	0.009
4 MONTH	Coefficient	2.790	0.001	**12.107**	4.403	6.713
	P-value	0.000	0.459	**0.003**	0.030	0.004
5 MONTH	Coefficient	2.760	0.001	**12.423**	4.779	6.103
	P-value	0.000	0.455	**0.013**	0.032	0.009
6 MONTH	Coefficient	2.634	0.001	**14.320**	5.641	5.551
	P-value	0.000	0.377	**0.004**	0.012	0.021
9 MONTH	Coefficient	2.509	0.002	**17.540**	6.357	5.019
	P-value	0.000	0.269	**0.004**	0.004	0.032
12 MONTH	Coefficient	2.281	0.002	**23.731**	7.201	5.259
	P-value	0.000	0.111	**0.000**	0.000	0.018
Panel D: None (call)		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	2.407	0.000	**7.301**	8.119	4.998
	P-value	0.000	0.932	**0.001**	0.004	0.055
2 MONTH	Coefficient	2.085	0.000	**12.705**	9.431	6.362
	P-value	0.000	0.840	**0.000**	0.001	0.031
3 MONTH	Coefficient	1.848	0.001	**17.924**	10.364	7.029
	P-value	0.000	0.569	**0.000**	0.000	0.027
4 MONTH	Coefficient	1.669	0.001	**21.579**	11.261	7.009
	P-value	0.000	0.401	**0.000**	0.000	0.010

Table 1-18—*Continued*

5 MONTH	Coefficient	1.570	0.001	**23.116**	12.063	6.223
	P-value	0.001	0.359	**0.000**	0.000	0.019
6 MONTH	Coefficient	1.431	0.002	**24.757**	13.331	4.762
	P-value	0.003	0.297	**0.000**	0.000	0.085
9 MONTH	Coefficient	1.339	0.002	**27.695**	14.075	3.429
	P-value	0.007	0.222	**0.000**	0.000	0.202
12 MONTH	Coefficient	1.099	0.003	**34.796**	14.942	3.470
	P-value	0.020	0.077	**0.000**	0.000	0.175
Panel E: Low (call)		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	3.996	-0.001	**7.836**	1.903	-5.722
	P-value	0.000	0.666	**0.001**	0.549	0.076
2 MONTH	Coefficient	3.682	0.000	**12.935**	3.281	-4.661
	P-value	0.000	0.821	**0.000**	0.257	0.072
3 MONTH	Coefficient	3.587	0.000	**15.030**	3.967	-5.412
	P-value	0.000	0.941	**0.000**	0.138	0.035
4 MONTH	Coefficient	3.458	0.000	**17.617**	4.667	-5.604
	P-value	0.000	0.952	**0.000**	0.081	0.054
5 MONTH	Coefficient	3.299	0.000	**20.529**	5.549	-5.732
	P-value	0.000	0.853	**0.000**	0.056	0.033
6 MONTH	Coefficient	3.157	0.001	**22.352**	6.740	-6.946
	P-value	0.000	0.772	**0.000**	0.021	0.010
9 MONTH	Coefficient	3.060	0.001	**25.318**	7.471	-8.101
	P-value	0.000	0.649	**0.000**	0.007	0.011
12 MONTH	Coefficient	2.752	0.002	**33.777**	8.606	-7.814
	P-value	0.000	0.349	**0.000**	0.001	0.015
Panel F: High (call)		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	3.409	0.003	**5.708**	2.907	0.591
	P-value	0.000	0.056	**0.003**	0.234	0.790
2 MONTH	Coefficient	3.113	0.003	**10.909**	3.974	2.218
	P-value	0.000	0.027	**0.000**	0.101	0.338
3 MONTH	Coefficient	2.904	0.004	**15.535**	4.787	2.855
	P-value	0.000	0.013	**0.000**	0.036	0.231
4 MONTH	Coefficient	2.780	0.004	**18.014**	5.488	2.584
	P-value	0.000	0.008	**0.000**	0.020	0.212

Table 1-18—*Continued*

5 MONTH	Coefficient	2.725	0.004	**18.698**	6.076	1.743
	P-value	0.000	0.010	**0.001**	0.024	0.422
6 MONTH	Coefficient	2.551	0.004	**21.255**	7.322	0.844
	P-value	0.000	0.006	**0.000**	0.007	0.700
9 MONTH	Coefficient	2.340	0.005	**26.571**	8.484	0.139
	P-value	0.000	0.002	**0.000**	0.001	0.952
12 MONTH	Coefficient	2.078	0.006	**34.094**	9.439	0.268
	P-value	0.000	0.000	**0.000**	0.000	0.904
Panel G: None (put)		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	1.601	0.003	**1.663**	5.772	13.260
	P-value	0.000	0.021	**0.368**	0.005	0.001
2 MONTH	Coefficient	1.495	0.003	**3.604**	6.101	13.978
	P-value	0.000	0.016	**0.172**	0.004	0.001
3 MONTH	Coefficient	1.438	0.004	**4.866**	6.347	14.070
	P-value	0.000	0.013	**0.151**	0.002	0.001
4 MONTH	Coefficient	1.427	0.004	**5.042**	6.501	13.764
	P-value	0.000	0.011	**0.247**	0.002	0.001
5 MONTH	Coefficient	1.437	0.004	**4.698**	6.592	13.363
	P-value	0.000	0.013	**0.333**	0.002	0.001
6 MONTH	Coefficient	1.409	0.004	**5.013**	6.847	13.062
	P-value	0.000	0.012	**0.311**	0.001	0.001
9 MONTH	Coefficient	1.393	0.004	**5.558**	6.988	12.784
	P-value	0.001	0.012	**0.385**	0.002	0.001
12 MONTH	Coefficient	1.261	0.004	**8.859**	7.488	13.030
	P-value	0.002	0.008	**0.202**	0.001	0.001
Panel H: Low (put)		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	3.432	-0.005	**3.594**	-1.808	10.122
	P-value	0.000	0.004	**0.037**	0.396	0.004
2 MONTH	Coefficient	3.380	-0.005	**3.901**	-1.262	9.442
	P-value	0.000	0.004	**0.079**	0.534	0.008
3 MONTH	Coefficient	3.325	-0.005	**5.119**	-1.007	9.476
	P-value	0.000	0.006	**0.071**	0.613	0.008
4 MONTH	Coefficient	3.168	-0.005	**8.448**	-0.500	10.312
	P-value	0.000	0.008	**0.028**	0.800	0.003

Table 1-18—*Continued*

5 MONTH	Coefficient	3.149	-0.005	**8.638**	-0.242	9.877
	P-value	0.000	0.009	**0.066**	0.910	0.005
6 MONTH	Coefficient	3.051	-0.005	**10.181**	0.398	9.544
	P-value	0.000	0.010	**0.048**	0.859	0.008
9 MONTH	Coefficient	2.987	-0.005	**11.945**	0.808	9.083
	P-value	0.000	0.009	**0.034**	0.716	0.005
12 MONTH	Coefficient	3.077	-0.005	**10.678**	0.429	8.553
	P-value	0.000	0.006	**0.067**	0.836	0.006
Panel I: High (pall)		*Intercept*	*trend*	***lret***	*disp*	*misg*
1 MONTH	Coefficient	2.904	-0.003	**0.563**	2.385	10.890
	P-value	0.000	0.042	**0.712**	0.166	0.000
2 MONTH	Coefficient	2.836	-0.002	**1.949**	2.527	11.552
	P-value	0.000	0.048	**0.349**	0.146	0.000
3 MONTH	Coefficient	2.785	-0.002	**3.073**	2.697	11.798
	P-value	0.000	0.057	**0.233**	0.110	0.000
4 MONTH	Coefficient	2.766	-0.002	**3.436**	2.822	11.697
	P-value	0.000	0.059	**0.347**	0.096	0.000
5 MONTH	Coefficient	2.769	-0.002	**3.297**	2.897	11.453
	P-value	0.000	0.059	**0.436**	0.094	0.000
6 MONTH	Coefficient	2.708	-0.002	**4.343**	3.223	11.432
	P-value	0.000	0.069	**0.323**	0.066	0.000
9 MONTH	Coefficient	2.718	-0.002	**4.317**	3.252	11.112
	P-value	0.000	0.076	**0.423**	0.074	0.000
12 MONTH	Coefficient	2.554	-0.002	**8.248**	3.879	11.476
	P-value	0.000	0.138	**0.149**	0.032	0.000

1.4.2.2.4. Sample sorted into portfolios based on institutional ownership. One last test here in examining firm characteristics in affecting investor overconfidence is to look at the influences from institutional ownership. Intuitively, institutional investors are more sophisticated and therefore are less likely subject to behavioral biases. Table 1-19 suggests it is not the case. Using dummy variable to account for the degree of institutional ownership (1 if percentage of institutional ownership is higher than median, 0

otherwise), I found institutional ownership has virtually no effect in the series of regressions. It is understandable that institutional investors may not use options in speculation, and therefore the firms with higher institutional ownership can hardly show any significant difference from the ones with lower institutional ownership.

Table 1-19 OLS regression on option turnover rates (institutional ownership subsample)

Panel A: Call + Put		*Intercept*	*trend*	***Iret***	*disp*	*misg*	*INST*	***INST * Iret***
1 MONTH	Coefficient	3.061	0.000	**4.112**	3.178	5.188	0.047	**-1.185**
	P-value	0.000	0.701	**0.025**	0.028	0.003	0.608	**0.590**
2 MONTH	Coefficient	2.865	0.001	**7.847**	3.848	6.358	0.049	**-1.658**
	P-value	0.000	0.502	**0.001**	0.009	0.001	0.591	**0.572**
3 MONTH	Coefficient	2.724	0.001	**11.060**	4.381	6.818	0.049	**-1.907**
	P-value	0.000	0.312	**0.000**	0.002	0.001	0.592	**0.589**
4 MONTH	Coefficient	2.643	0.001	**12.375**	4.844	6.664	0.046	**-1.192**
	P-value	0.000	0.226	**0.003**	0.001	0.000	0.628	**0.815**
5 MONTH	Coefficient	2.609	0.001	**12.295**	5.228	6.113	0.042	**-0.142**
	P-value	0.000	0.218	**0.014**	0.001	0.001	0.671	**0.981**
6 MONTH	Coefficient	2.494	0.001	**13.499**	6.057	5.545	0.037	**0.960**
	P-value	0.000	0.154	**0.008**	0.000	0.002	0.708	**0.879**
9 MONTH	Coefficient	2.401	0.002	**15.227**	6.657	4.943	0.029	**2.742**
	P-value	0.000	0.090	**0.014**	0.000	0.004	0.779	**0.711**
12 MONTH	Coefficient	2.196	0.002	**20.921**	7.411	5.138	0.029	**2.557**
	P-value	0.000	0.019	**0.001**	0.000	0.002	0.778	**0.738**
Panel B: Call		*Intercept*	*trend*	***Iret***	*disp*	*misg*	*INST*	***INST * Iret***
1 MONTH	Coefficient	3.330	0.002	**6.269**	3.451	0.910	0.022	**-1.597**
	P-value	0.000	0.050	**0.002**	0.039	0.599	0.828	**0.504**
2 MONTH	Coefficient	3.052	0.002	**11.477**	4.468	2.391	0.025	**-2.318**
	P-value	0.000	0.018	**0.000**	0.008	0.180	0.804	**0.470**
3 MONTH	Coefficient	2.855	0.003	**15.977**	5.234	2.979	0.025	**-2.633**
	P-value	0.000	0.005	**0.000**	0.001	0.107	0.800	**0.471**
4 MONTH	Coefficient	2.729	0.003	**18.120**	5.922	2.811	0.021	**-1.764**
	P-value	0.000	0.002	**0.000**	0.000	0.092	0.834	**0.742**
5 MONTH	Coefficient	2.670	0.003	**18.497**	6.510	2.062	0.018	**-0.845**
	P-value	0.000	0.002	**0.001**	0.000	0.211	0.869	**0.899**

Table 1-19—*Continued*

6 MONTH	Coefficient	2.510	0.003	**20.169**	7.696	1.170	0.012	**0.553**
	P-value	0.000	0.001	**0.000**	0.000	0.482	0.914	**0.936**
9 MONTH	Coefficient	2.349	0.004	**23.590**	8.664	0.365	0.004	**2.331**
	P-value	0.000	0.000	**0.001**	0.000	0.831	0.975	**0.775**
12 MONTH	Coefficient	2.102	0.005	**30.573**	9.565	0.494	0.002	**2.515**
	P-value	0.000	0.000	**0.000**	0.000	0.766	0.984	**0.761**
Panel C: Put		*Intercept*	*trend*	***Iret***	*disp*	*misg*	*INST*	***INST * Iret***
1 MONTH	Coefficient	2.607	-0.001	**0.618**	2.806	10.483	0.106	**-0.283**
	P-value	0.000	0.285	**0.704**	0.022	0.000	0.231	**0.894**
2 MONTH	Coefficient	2.539	-0.001	**2.015**	2.935	11.169	0.106	**-0.290**
	P-value	0.000	0.332	**0.364**	0.018	0.000	0.234	**0.919**
3 MONTH	Coefficient	2.491	-0.001	**3.088**	3.096	11.395	0.106	**-0.326**
	P-value	0.000	0.389	**0.270**	0.011	0.000	0.243	**0.928**
4 MONTH	Coefficient	2.474	-0.001	**3.182**	3.217	11.308	0.104	**0.221**
	P-value	0.000	0.412	**0.413**	0.008	0.000	0.269	**0.964**
5 MONTH	Coefficient	2.479	-0.001	**2.395**	3.287	11.069	0.099	**1.500**
	P-value	0.000	0.408	**0.586**	0.008	0.000	0.300	**0.785**
6 MONTH	Coefficient	2.430	-0.001	**2.899**	3.575	11.018	0.095	**2.222**
	P-value	0.000	0.462	**0.527**	0.004	0.000	0.318	**0.699**
9 MONTH	Coefficient	2.455	-0.001	**1.787**	3.556	10.685	0.087	**3.904**
	P-value	0.000	0.463	**0.744**	0.006	0.000	0.372	**0.555**
12 MONTH	Coefficient	2.332	0.000	**5.016**	4.020	10.943	0.089	**3.356**
	P-value	0.000	0.683	**0.391**	0.002	0.000	0.372	**0.639**

1.5 Conclusion

This study examines investor overconfidence in options market. According to Odean (1998) and Gervias and Odean (2001), noise traders attribute superior return in a rising market to their own trading skills. Consistent with this, Statman, Thorley, and Vorkink (2006) find a positive relationship between past market return and stock turnover. We test if past market return is directly related to options turnover. I find a positive relationship between past market returns and option trading activities even after

controlling for other incentives to trade, including market volatility and idiosyncratic risks of individual companies. This finding is consistent with the hypothesis that if investors enjoy better performance along with the whole market, they become overconfident in their trading and security valuation skills, and consequently trade more aggressively. I also argue that as call options are more likely to be the trading vehicle for overconfident investors to trade for speculation, especially in a bull market, the effect of overconfidence is mainly through the trading of call options. Consistent with this argument, I find a positive relationship between call-to-put ratio and lagged market return.

I also argue that options on stocks with low book-to-market equity and on stocks without financial analyst following are more likely to be affected by investor overconfidence. For stocks with a low book-to-market equity, or growth stocks, the reason could be that more noise traders exist in this specific market. Growth stocks typically draw more public attention, and therefore may attract more noise traders. A lack of information efficiency may be the reason why stocks without financial analyst coverage are more likely to be affected. I find evidence consistent with these arguments as the positive relationship between past stock market return and option trading activity is stronger for growth firms and firms without analyst coverage.

The evidence in this study that investor overconfidence is a plausible reason for options trading could help us improve our understanding of the characteristics of option market participants. For practitioners, the existence of overconfident investors induces an additional sentiment risk, which needs to be taken into account in creating hedging portfolios. For academics, I provide an alternative explanation for the excessive volatilities in equity market returns. The options market was supposed to create an efficient venue for investors to transfer risks, so that risks are better allocated to meet investors' different risk preferences and therefore enhance the overall utility. However,

the presence of overconfident investors may create additional risks not only in the equity market but also in the options market.

One potential extension to this study would be to examine the effects of investor overconfidence on option as well as underlying equity pricing. If investors become overconfident and consequently trade more aggressively, the option prices would likely be affected and potentially deviate from fundamentals. While equity prices are not directly affected, the boundary conditions between options and underlying assets may be violated, causing the market to react. It would be interesting to investigate the issue. In addition, this study focuses exclusively on the overconfidence stimulated by past market returns. Investors can get overconfident even if they are not so successful in their past trading experience. The excessive trading behavior in recent years, in both equity and in options market, may only partially attribute to investor overconfidence induced by high past returns. During the years of 2008 and 2009, we had experienced a major market downturn, but the trading remained high during those years. It would be worthwhile to pursue the reasons of trading other than purely hedging in a normal or bear market.

Last but not the least, by contrasting the analyses using full sample and the ones using observations before 2008, I find evidence showing investors attitude toward market volatility might have changed since the most recent financial crisis. Further study of this issue would help understand investors' attitude toward risk during and after an extreme economic event, and would be a good contribution to behavioral finance**.**

Chapter 2

Excess Option Trading, Volatility, and Investor Overconfidence

2.1 Introduction

Trading behaviors in options markets have drawn attention from financial economists, as options market grows its importance in the U.S. financial markets especially in recent years. While options can be replicated in a complete market and therefore are redundant (Black and Scholes, 1973), the market for this financial instrument has only grown larger and larger. Many financial scholars have been attracted by the fact and devote themselves into the study of the market. Some researchers in this area have been striving to interpret the information content embedded in the trading behaviors. However, it is difficult to read and translate the information correctly if we fail to identify the actual motives of trading. Along this line of literature, scholars have identified two main scopes in regards to rational incentives of trading. One is differences of opinion, while the other is superior information. Both arguments suggest that investors trade because they hold different belief(s) from that of the general market participants, which is reflected in the current market prices. The main distinction between the two is that information-driven hypothesis assumes investors who trade either possess private information, while differences-in-opinion hypothesis suggests investors interpret the same information differently. While we observe the same increase in trading activities, the two hypotheses generate distinct inferences on how asset prices react to this information. Therefore, the understanding of reasons of trading is crucial to all the studies related to this field.

The studies on identifying the reasons of trading options have shown mixed results at their best. Starting from Black (1975), who argues that the leverage effects in options can attract informed traders, Amin and Lee (1997), Easley et al. (1998), Kaul et

al. (2004), Cao et al. (2005), and Pan and Poteshman (2006) have found evidence supporting information driven hypothesis. On the other hand, Stephen and Whaley (1990), Vijh (1990), Chan et al. (1993, 2002), Muravyev et al. (2012), and Choy and Wei (2012) present evidence against informed trading. Also, in the first chapter, I, following the work of Statman, Thorley, and Vorkink (2006) to examine the relationship between past market return and subsequent trading activities, have presented evidence showing the existence of investor overconfidence in options market. The presence of investor overconfidence in options market brings a bigger question: what can trading activities in options market tell us? While it has been shown in the literature that options market plays an important information role (eg. Chakravarty, Hulen, and Mayhew, 2004), one may wonder what effects investor overconfidence may bring into options market in processing of information. According to Scheinkman and Xiong (2003), investor overconfidence may intensify differences of opinion in the form of overly optimism for overconfident agents, and consequently create a price bubble. Also, the bubbles come along with large trading volume as well as high price volatility. Therefore, empirically examining whether there is a linkage between trading activities and measures of price bubbles and between trading and volatility is meaningful to the understanding of options trading and its information content.

This chapter addresses two main research questions. First, investigate the relationships between option trading activities and option price and volatility over time. That is, I examine whether there is higher/lower volatility or discrepancy in option prices coming along with higher option turnover rate. Second, whether investor sentiment affects option pricing cross-sectionally. In a nutshell, options with higher turnover rate may behave differently than those with lower turnover rate, given option turnover rate used as a measure of investor sentiment or investor overconfidence. As stated above,

investor overconfidence may intensify differences of opinion, and therefore facilitates trading activities. Regardless of the venue they choose to trade, overconfident agents may try to take advantage of their own information (or beliefs) and therefore trade more frequently. Therefore, I use option turnover rate as a proxy for investor overconfidence, and test the hypotheses of relationships between overconfidence and option volatility and option pricing. In chapter 1, I also present evidence showing that call option trading turnover ratio increases along with past market performance while put option turnover ratio does not necessarily so. This suggests overconfident investors may use call options as main trading vehicles. The trading activities induced by overconfident agents should influence the market in a different way, because of them holding different beliefs. Specifically, as overconfident agents trade more often on call options market, the demand on call options should be augmented. As a consequence, the call options may become more expensive relative to put options. Cremers and Weinbaum (2010) use the difference in implied volatility between pairs of call and put options (volatility spread) to measure the relative expensiveness of call options over put options. Volatility spread may serve as a good indicator in examining whether call options become more expensive relative to corresponding put options, when the market presents evidence of overconfidence. As stated above, I expect to observe a positive relationship between overconfidence measure and volatility spread.

2.2 Literature Review

2.2.1. Overconfidence and Momentum

It is well documented in the finance literature about momentum (Jegadeesh and Titman, 1993) and reversals (DeBondt and Thaler, 1985). While a momentum strategy that buys winning stocks and short sells losing stocks generates superior average returns

in the short run, it results in negative average returns in the long run (reversals). A simple but popular explanation that fits both of the phenomena is behavioral. Behavioral theories that try to address the issue include Barberis, Shleifer, and Vishny (1998), Daniel, Hirshleifer, and Subrahmanyam (1998, 2001), Hong and Stein (1999), and George and Hwang (2004). Among those theories, Daniel, Hirshleifer, and Subrahmanyam (1998) attribute the phenomena to the behaviors of overconfidence agents. In their framework, investors bear self-attribute bias that they tend to attribute their success in investment to their own trading skills and knowledge and blame their failure on bad luck or unpredictable noises. This theory is empirically supported by Lee and Swaminathan (2000), Statman, Thorley and Vorkink (2006), and Cremers and Pareek (2011), to name a few. While evidence from stock markets generally supports self-attribute bias, even for institutional investors (Cremers and Pareek, 2011), the existence and the potential influence of such bias are largely not discussed in the literature.

2.2.2. Price Patterns in Options Market

Options market pricing has been intriguing financial economists in various ways for decades. One of the heavily discussed topics is the existence of arbitrage opportunities. At first the options are deemed as redundant securities (Black and Scholes (1973) and Cox, Ross and Rubenstein (1979)), and by nature investors should have no reason to trade on such financial instrument. However, scholars have empirically identified deviations from basic option pricing rules such as put-call parity (eg. Lamont and Thaler (2003), Ofek and Richardson (2003), and Ofek, Richardson, and Whitelaw (2004)), which provide incentives for investors to trade in the options market. The argument about the existence of arbitrage opportunities goes on as other researchers show evidence against those findings (eg. Battalio and Schultz (2006)). Even if there exists deviations from no-arbitrage relations, most would agree the arbitrage

opportunities dissipate fairly quick. They can hardly account for the extensive trading activities in options market. Cremers and Weinbaum (2010), on the other hand, argue that the relative expensiveness between put and call options, paired by strike price and underlying security, may predict future stock performance. Their findings further provide reasons of trading, as they argue the predictability coming from mispricing of options. Coincided with Cremers and Weinbaum (2010), Xing, Zhang, and Zhao (2010) find that the shape of volatility smirk predicts future stock returns. Some papers suggest informed traders may lead the trading in options market due to leverage (Black (1975)), and therefore reveal their information in option prices. While others argue differences of opinions are the main reasons of trading (Choy and Wei (2012)), the causes of differences of opinions remain largely uninvestigated.

2.3 Research Questions and Empirical Methodologies

This study is aiming to empirically test the relationships between trading activities and asset prices in options market. As suggested in Scheinkman and Xiong (2003), investor overconfidence intensifies differences of opinions and therefore causes heavier trading. Higher volatilities as well as price bubbles come along with heavier trading. Therefore, the main question would be when investor overconfidence presents and consequently more active trading is observed, whether or not price bubble would be created and higher price volatilities would be induced. As suggested in the first chapter, investor overconfidence may be accumulated over time, and is realized in excess trading activities. Derived from this finding, I propose a measure of investor overconfidence based on option trading activities.

2.3.1. Empirical Methodologies

Following Statman, Thorley, and Vorkink (2006), two control variables are used to account for normal trading motives. The first variable is market volatility, *misg*, based

upon the research by Karpoff (1987) on the contemporaneous volume-volatility relationship. The second variable is dispersion, *disp*, which is associated with idiosyncratic risk in the underlying stock and therefore accounts for trading activities related to portfolio rebalancing. In addition, I also include proportional effective spread, *sprd*, to control for liquidity. Specifically, proportional effective spread for underlying equity *j* on day *D* is calculated as follow:

$$sprd_{D,j} = {}^{1}/_{Vol_{D,j}} \sum_{k=1}^{n} Vol_{D,j,k} * 100 * \frac{2 * (Offer_{D,j,k} - Bid_{D,j,k})}{(Offer_{D,j,k} + Bid_{D,j,k})}$$

where $Vol_{D,j} = \sum_{k=1}^{n} Vol_{D,j,k}$, and *k* stands for different strike price. The main measure of trading volume used in this study is option trading turnover, *TO_O*, which is defined as option trading volume times 100 scaled by open interests. The model is as following:

$$TO\_O_t = a + b_1 * misg_t + b_2 * disp_t + b_3 * sprd_t + \varepsilon_t$$

I extract the residuals from the regression and use them as a measure of overconfidence over time. In addition to the measure above, I also apply the technique of stochastic frontier analysis (SFA) to isolate the potential trading behaviors due to overconfidence from those based on random information flows. The rationale behind using SFA in this study is that I treat overconfidence a systematic bias for investors, which constantly drives up trading volume. Since standard ordinary least square method does not distinguish between systematic bias in trading and purely stochastic component in trading activities, SFA's capability of capturing the systematic bias as skewness in residuals would help in extracting trading activities due to overconfidence. Empirically, I adopt the following regression model:

$$TO\_O_t = a + b_1 * misg_t + b_2 * disp_t + b_3 * sprd_t + v_t + u_t$$

where u_t is a one-sided error half normally distributed $N(0^{+}, \sigma_u^2)$. I adopt two inefficiency measures in this study. Both are based on the technical efficiency measures. That is

$OC_i = 1 - TE_i$, where I = 1, 2.

TE_1 is the technical efficiency measure used in Battese and Coelli (1988), and TE_2 is the technical efficiency measure used in Jondrow et al. (1982).

Once the overconfidence measure is obtained, I test the relationships between the measure and price volatility and price bubble measures. For volatility, I use the following two measures: VIX and realized volatility over the past 30 days. The changes of volatilities are also included as a dependent variable. For price bubble measures, I use volatility spread and volatility smirk (skewness). Volatility spread, proposed by Cremers and Weinbaum (2010), measures the relative expensiveness between calls and puts with the same strike price. Cremers and Weinbaum find that the stocks with relative expensive calls outperform stocks with relative expensive puts. They also document this finding is likely due to information risk faced by the underlying stocks. If investors in options market are overly optimistic to the performance of underlying stocks, we should observe more expensive call options relative to put options with the same strike on the market. In such case, the subsequent superior performance they have documented may be explained as the confidence building up in the options market spilling over to the underlying stock market. Similar argument can be applied to volatility smirk, which measures the relative expensiveness between in-the-money and out-of-the-money calls (puts). As of the case for calls, the general explanation to the phenomenon is that in-the-money call options offers leverage and therefore is a more favorable option for investors who wish to take long positions. As investors become overly optimistic, we should observe more expensive in-the-money call options and less expensive out-of-the-money put options (less hedging activities using puts). Consequently, volatility smirk for calls (puts) will become steeper (flatter).

2.3.2. Testing Hypothesis

The following hypotheses will be tested in the following sections:

H1: Higher investor overconfidence will lead to higher expected as well as subsequent realized volatility.

H2: Higher investor overconfidence will make call options more expensive relative to corresponding put options with the same strike price.

H3: Higher Investor overconfidence will result in more expensive in-the-money/at-the-money call options relative to the out-of-the-money ones and less expensive out-of-the-money put options relative to the in-the-money/at-the-money ones.

Time series regressions are conducted to test the hypotheses above. In addition to finding the relationships between investor overconfidence and asset prices over time, I also plan to examine the impacts across firms. Both of Cremers and Weinbaum (2010) and Xing, Zhang, and Zhao (2010) find differences in implied volatilities predict future equity returns. While Cremers and Weinbaum (2010) indicate mispricing seems to be the main reason of the finding, Xing, Zhang, and Zhao (2010) argue informed traders may be the driven forces. In both studies, sample firms are sorted into portfolios according to volatility spread/skew/smirk, and then the authors show differences in future performance across portfolios. If investor overconfidence plays certain role in their findings, one should expect to find overconfidence measures are associated with volatility spread/skew/smirk cross-sectionally. For instance, Cremers and Weinbaum (2010) find stocks with more expensive calls or with calls becoming more expensive from the previous period earn abnormal positive returns, while the ones with more expensive puts or with puts becoming more expensive from the previous period earn abnormal negative returns. If firms with more frequent trading activities generally have more expensive calls, the subsequent abnormal returns documented by Cremers and Weinbaum (2010) may be

the price bubble suggested by Scheinkman and Xiong (2003). Similar argument applies to predictability of future stock returns according to volatility skew/smirk argued by Xing, Zhang, and Zhou (2010). Therefore, I conduct a second series of tests to examine the relationships between trading activities and volatility spread/skew/smirk across firms.

2.3.3. Data

The option data is retrieved from OptionMetrics via WRDS. End-of-day bid and ask quotes, open interests, trading volume, and implied volatility are obtained from the database for the sample period of January 1996 to December 2011. As in the first chapter, O/S ratio is used as a measure of trading activities. Since different practices in reporting trading volume in dealers markets may cause inconsistency in O/S ratio, the sample in this study only consists of firms listed on NYSE/AMEX with options. VIX, a forward volatility index proposed by CBOE, is used as a measure of volatility for the entire market. End-of-day stock prices and trading volume are extracted from Center for Research in Security Prices (CRSP). In the second part of study where cross-sectional analyses are performed, Fama-French three factors are used to adjust future portfolio returns. The necessary information for performing the tasks is obtained from Kenneth French's website[8].

Table 2.1 contains descriptive statistics for all the variables used in empirical analyses. Panel A shows characteristics of the main dependent variables used in the empirical studies. Note that the volatility changes have means and medians closed to zero. Interestingly, while both VIX and realized volatility changes present largest figures during the financial crisis (from 2007 to 2009), the signs of the figures are different. Volatility spreads have a negative mean, as reported in Cremers and Weinbaum (2010), while volatility skews are generally positive, consistent with Xing et al. (2010).

[8] The URL is http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

Table 2-1 Sample Characteristics

Panel A: Volatility measures and price discrepancy measures

Variables	% Change in VIX			% Change of 30-day Volatility			30-day Realized Volatility			Volatility Spread			Volatility Skew		
Year	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
1996	-0.0263	-0.0130	0.0913	0.0016	0.0018	0.0114	0.4244	0.3973	0.0465	-0.0065	-0.0067	0.0023	0.0323	0.0312	0.0129
1997	-0.0106	-0.0133	0.1137	-0.0008	-0.0017	0.0071	0.4152	0.3987	0.0575	-0.0107	-0.0103	0.0023	0.0333	0.0316	0.0149
1998	0.0035	0.0106	0.1884	0.0008	0.0018	0.0121	0.4828	0.4495	0.0931	-0.0097	-0.0093	0.0023	0.0398	0.0361	0.0211
1999	0.0197	0.0064	0.0906	0.0005	0.0008	0.0065	0.5148	0.5146	0.0485	-0.0113	-0.0110	0.0026	0.0298	0.0298	0.0097
2000	0.0008	0.0122	0.1196	0.0011	0.0019	0.0116	0.6054	0.6193	0.0710	-0.0074	-0.0071	0.0022	0.0325	0.0304	0.0130
2001	0.0244	0.0652	0.1685	-0.0008	-0.0002	0.0179	0.5501	0.5277	0.1044	-0.0061	-0.0061	0.0024	0.0566	0.0557	0.0111
2002	-0.0074	-0.0053	0.1453	-0.0002	0.0000	0.0140	0.5645	0.5477	0.1154	-0.0067	-0.0067	0.0014	0.0835	0.0755	0.0253
2003	0.0501	0.0404	0.1050	-0.0031	-0.0019	0.0084	0.3621	0.3733	0.0602	-0.0069	-0.0069	0.0012	0.0482	0.0455	0.0161
2004	0.0202	-0.0015	0.1059	0.0008	-0.0051	0.0150	0.3065	0.3102	0.0248	-0.0072	-0.0076	0.0013	0.0339	0.0338	0.0076
2005	0.0168	0.0304	0.1300	0.0006	-0.0004	0.0219	0.2998	0.2832	0.0570	-0.0108	-0.0104	0.0021	0.0366	0.0349	0.0110
2006	0.0119	0.0191	0.0991	-0.0017	0.0007	0.0106	0.2936	0.2850	0.0320	-0.0084	-0.0083	0.0011	0.0315	0.0308	0.0085
2007	-0.0523	-0.0689	0.1806	0.0033	0.0049	0.0122	0.3311	0.3030	0.0906	-0.0075	-0.0073	0.0009	0.0337	0.0312	0.0152
2008	-0.0147	-0.0046	0.2319	0.0031	0.0012	0.0209	0.7938	0.7032	0.3333	-0.0151	-0.0137	0.0067	0.0822	0.0660	0.0421
2009	0.0685	0.0307	0.0688	-0.0041	-0.0051	0.0106	0.6865	0.5671	0.2873	-0.0243	-0.0125	0.0217	0.0653	0.0516	0.0285
2010	0.0331	0.0502	0.1782	-0.0002	-0.0031	0.0091	0.3588	0.3437	0.0651	-0.0034	-0.0037	0.0026	0.0433	0.0397	0.0152
2011	-0.0115	-0.0066	0.2024	0.0017	-0.0007	0.0135	0.3977	0.3198	0.1374	-0.0037	-0.0015	0.0046	0.0508	0.0372	0.0270
All	0.0164	-0.0145	0.1800	0.0002	0.0001	0.0130	0.4617	0.4193	0.1914	-0.0091	-0.0079	0.0076	0.0458	0.0387	0.0237

Table 2-1—*Continued*

Panel B: Overconfidence measures

Variables		Option Turnover			OLS Residual			OC1			OC2		
Year	Number of Stocks	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
1996	474	4.6791	4.5330	0.6846	1.1826	1.0440	0.6540	2.7921	2.8303	0.7040	2.8324	2.8697	0.7233
1997	801	4.5390	4.6345	0.5690	0.9335	0.9591	0.5546	3.1651	2.9466	0.8645	3.2169	2.9893	0.8925
1998	1005	4.1890	3.9860	0.5090	0.4864	0.3920	0.5305	3.7647	3.9212	0.9183	3.8363	3.9954	0.9512
1999	1180	3.9635	3.6965	0.6344	-0.0478	-0.2065	0.6587	6.4284	6.0324	3.0229	6.6354	6.1992	3.1851
2000	1146	3.7991	3.7398	0.5311	-0.5567	-0.5214	0.4352	10.0992	8.5091	5.1406	10.5222	8.8155	5.4672
2001	961	3.4399	3.1770	0.7049	-0.6609	-0.9468	0.5595	11.1985	12.8566	5.4631	11.6998	13.4498	5.8027
2002	980	3.0145	2.9817	0.5648	-0.9237	-0.9755	0.5345	16.1020	13.1623	10.1234	16.8484	13.7763	10.6674
2003	1099	2.8166	2.8210	0.2697	-0.8532	-0.8715	0.2048	11.2559	9.9621	4.4005	11.7388	10.3604	4.6782
2004	1064	2.8354	2.6686	0.6513	-0.6553	-0.7547	0.4966	11.4130	10.2872	5.3123	11.9183	10.7069	5.6481
2005	1166	3.1266	3.1183	0.3066	-0.3993	-0.4746	0.2994	7.7116	7.6512	2.0858	7.9780	7.9061	2.2054
2006	1226	3.5667	3.3614	0.5197	-0.0792	-0.2935	0.5134	6.7115	7.2288	2.5402	6.9277	7.4595	2.6754
2007	1366	3.6836	3.6432	0.4125	-0.0348	-0.0649	0.4474	6.2358	5.9837	2.1575	6.4239	6.1480	2.2694
2008	1430	4.1211	4.1415	0.6330	0.1922	0.1945	0.6411	4.4835	4.5249	1.5257	4.5867	4.6227	1.5899
2009	1510	5.1826	4.8918	0.9938	0.9556	0.9171	0.7949	3.1808	2.7113	1.5427	3.2389	2.7475	1.5979
2010	1542	4.4466	4.1338	0.8640	0.2715	-0.0445	0.8606	6.7525	6.8217	3.8423	6.9852	7.0303	4.0549
2011	1608	4.2802	4.1038	0.7989	0.1891	0.0737	0.7693	6.8790	6.0804	3.7342	7.1175	6.2499	3.9421
All	2779	3.8552	3.7904	0.9073	0.0000	-0.1522	0.8498	7.3858	5.7913	5.3460	7.6567	5.9459	5.6454

Panel B summarizes mean, median, and standard deviation for the explanatory variables, which are used as a proxy of investor overconfidence. In the first column, one may see this study uses in total 2,779 unique firms listed on NYSE/AMEX with options traded. The numbers of firms in the sample range from around 470 in 1996 to 1,600 in 2011. OC1 and OC2 are the inefficiency measures derived from stochastic frontier analysis (SFA), and are very similar qualitatively and quantitatively. I expect they would yield similar results in the main empirical analyses.

2.4 Empirical Results

As discussed in the previous section, the main question addressed in this study is whether or not investor overconfidence plays a role in option pricing. To investigate this issue, I conduct two series of tests. The first set of tests is running regressions on volatility measures and relative expensiveness across options against trading activities, which is used as a proxy for investor overconfidence. The second set of tests is sorting sample firms into portfolios based on trading activities, and examining the differences in volatility spread/skew/smirk across portfolios. This section states and elaborates the empirical results of the two sets of tests.

2.4.1. Time-Series Regressions

As I did in chapter 1, I aggregate trading volumes across all options for the entire sample firms in a day, and then the aggregated trading volume of options is divided by the end-of-the-day open interests to obtain trading turnover for options. For changes in VIX, I obtain daily VIX from WRDS, and then calculate the average VIX in a month. The changes of VIX are the percentage change in average VIX in the current month from the previous month. Daily realized volatilities for sample firms are obtained from OptionMetrics. For each month, realized volatilities during the past 30 calendar days are extracted daily and then average over the month. The changes of realized volatility are

the percentage change of average realized 30-day volatility in a given month from the previous month. Volatility spread is calculated daily for each sample firms and then average over a month. Following Cremers and Weinbaum (2010), I pair call and put options that have the same underlying equity, the same strike and the same maturity, and the calculate volatility spread as the difference between implied volatility of call and that of put option. As defined in Xing, Zhang, and Zhao (2010), implied volatility skew is calculated as the difference between the implied volatilities of OTM puts and ATM calls. An option is defined as OTM[9] when the absolute delta of the option is at least 0.125 but less than 0.375. It is defined as ATM when the absolute delta is at least 0.375 but less than 0.625, and finally it is defined as ITM when the absolute delta is at least 0.625 but less than 0.875. Daily volatility skew is averaged across sample firms in a day weighted by end-of-the-day open interests[10]. I compute monthly volatility skew by averaging the daily volatility skew over a month.

Table 2.2 presents the results of the first empirical test. As mentioned in the previous section, the explanatory variables are derived from the first stage regression. The residuals are extracted from the first stage regression using ordinary square method, controlling for market volatility, idiosyncratic risk, and proportional effective spread. OC1 and OC2 are inefficiency measures derived from stochastic frontier analysis, assuming half normal distribution in inefficiency. Specifically, they are 1 minus the technical efficiency measures, suggested by Battese and Coelli (1988) and by Jondrow et al. (1982), respectively. In the empirical studies later, I will show the two measures are quantitatively similar.

[8] There are several ways to determine moneyness of options. The simplest way is to use ratio of the strike price to the stock price (K/S). Ni (2007) uses total volatility-adjusted strike-to-stock-price ratio as another moneyness measure. However, alternative methods yield quantitatively similar results.

[10] Several other methods may be used to weight or to choose options included in calculating volatility skew. Choosing the representing option with highest volume or open interests has been used. Weighting options based on trading volume is another way.

Table 2-2 Univariate Analysis – Unexpected Turnovers on All Options against Volatility Measures and Price Discrepancy Measures

	Explanatory Variables		
Dependent Variables	OLS Residual	OC1	OC2
Percentage Change in VIX	0.0280**	-0.0050**	-0.0047**
	(0.0115)	(0.0020)	(0.0019)
Past 30 days realized volatility	0.0000	-0.0018	-0.0017
	(0.0205)	(0.0030)	(0.0028)
Volatility % Change - Past 30 days	0.0044***	-0.0072***	-0.0007***
	(0.0010)	(0.0014)	(0.0001)
Volatility Spread	-0.0018*	0.0003***	0.0003***
	(0.0011)	(0.0001)	(0.0001)
Changes in Volatility Spread	-0.0007	0.0001	0.0001
	(0.0006)	(0.0001)	(0.0001)
Volatility Skew	-0.0049**	0.0009**	0.0008**
	(0.0024)	(0.0004)	(0.0004)
Changes in Volatility Skew	0.0006	-0.0002	-0.0002
	(0.0010)	(0.0001)	(0.0001)
Call Volatility Smirk (ATM - OTM)	-0.0042**	0.0007***	0.0007***
	(0.0018)	(0.0002)	(0.0002)
Call Volatility Smirk (ITM - OTM)	-0.0077*	0.0013**	0.0012**
	(0.0040)	(0.0006)	(0.0005)
Put Volatility Smirk (ATM - OTM)	0.0048*	-0.0009**	-0.0008**
	(0.0025)	(0.0004)	(0.0004)
Put Volatility Smirk (ITM - OTM)	0.0095**	-0.0017***	-0.0016***
	(0.0038)	(0.0006)	(0.0005)

It is apparent that there are two different pictures captured in this table. First, look at the first column for the results from second stage regressions using OLS residuals as explanatory variables. OLS residuals used as a measure of investor overconfidence are concurrent with higher expected and realized volatility measures from the previous month, which serves as a piece of evidence supporting the theory in Scheinkman and Xiong (2003) that investor overconfidence intensifies differences of opinions and

consequently causes higher volatility. On the other hand, volatility spread is positively correlated with OLS residuals, while the changes of volatility spread does not have significant correlation with OLS residuals. This may be deemed that more frequent trading activities overall tend to make put options more expensive than call options. At first glance, it is rather difficult to reconcile the results with the negative correlation between OC1/OC2 and volatility skew, which indicates less hedging activities using OTM put options. Therefore, I further look into the difference in implied volatilities across moneyness of options. It is generally observed in equity option market that implied volatility skew is negative sloped across strike prices (higher implied volatility for ITM call options and OTM put options, relative to OTM call options and ITM put options). As shown in Figure 2.1, the pattern is clearly presented throughout the sample period, while it tends to be more severe during financial crisis. In both crises during the sample period, one may observe large spikes in both post dot-com bubble era and in the most recent financial crisis from 2007 to 2009. Also, one may also observe a tendency of steeper slope over time. In tests of slope of volatility skew/smirk, I find OLS residuals are concurrent to flatter slopes, which means less expensive ITM calls and OTM puts. The findings are indicated by negative(positive) coefficients on volatility smirk for call(put) options, and the coefficients are statistically significant at 10% level. A natural explanation to this finding may be overconfident agents try to take chances in options market and therefore generate higher demand on OTM call options, while they are less worried about market crashes and consequently create less demand on put options. While the finding from the slopes of volatility smirk is consistent with the one from volatility skew, this still does not explain lower volatility spread. One possibility is that volatility spread is weighted by open interests[11], and therefore reflects more the relative

[11] The same argument still applies even if trading volume is used for calculating weighted average.

expensiveness between ATM call and put options. That is, ATM call options become less expensive than ATM put options. This might be due to the common trading strategy of covered call, which sells short ATM call options instead of dumping underlying equity into the market to increase portfolio returns.

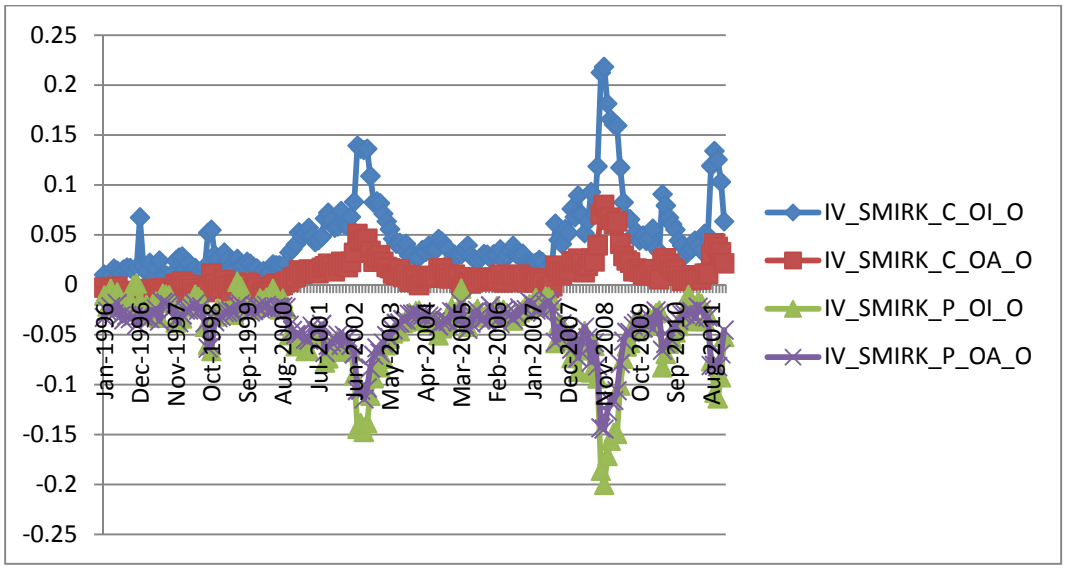

Figure 2-1 Volatility smirk over time

I also use inefficiency measures from SFA as a measure of investor overconfidence, and find a very different picture. OC1 and OC2 both are negatively correlated with changes in volatility measures from the previous month, while they are positively correlated with volatility spread. In addition, there is a positive correlation between investor overconfidence measures and steepness of volatility smirk across strike prices. As explained in the methodology section, OC1 and OC2 are technical inefficiency measures derived from SFA. Therefore, I see them as overly aggressive trading activities and therefore a proxy for investor overconfidence. The results, in large, do not agree with the argument. First, by looking at the regressions on volatility measures, I find negative and statistically significant coefficients. This suggests OC1 and OC2 captures trading

activities when option prices are relatively stable and are expected to be stable also in the future. The findings from volatilities are consistent with the ones from volatility skew/smirk. A general argument to the existence of volatility skew/smirk is that investors are worried about market crash and therefore would like to protect their holdings by buying more OTM put options. Another popular explanation is that investors use ATM/ITM call options in lieu of their stock investments to enhance rates of return. Both explanations are supported in this line of tests, given that OC1/OC2 are positively correlated with volatility skew (more expansive OTM puts than ATM calls) and with the slope of volatility smirk. Again, volatility spread shows positive correlation with OC1/OC2, which may seem contradicting with previous argument. As explained above, ATM call and put options may be driving this finding.

I conduct similar tests using call and put option turnover ratios in Table 2.3 and Table 2.4, respectively, to examine if trading activities associated with call and put options could respectively provide different sets of information. The results are qualitatively similar across three tables, as most of coefficients appear in the same signs with their corresponding peers in all three tables and no surprisingly larger or smaller coefficient is identified. The only noticeable difference is that put option turnover seems to have better explanatory power on volatility skew/smirk, which is consistent with the argument that investors in options market are in favor of using put options to avoid huge loss in major market crash. The findings are more pronounced when OC1 and OC2 are used as measures of excessive trading, which may suggest the inefficiency trading measures derived from SFA capture investors' fear toward market crashes.

Table 2-3 Univariate Analysis – Unexpected Turnovers on Call Options against Volatility Measures and Price Discrepancy Measures

	Explanatory Variables		
Dependent Variables	OLS Residual	OC1	OC2
Percentage Change in VIX	0.0266**	-0.0063***	-0.0060***
	(0.0135)	(0.0023)	(0.0022)
Past 30 days realized volatility	0.0161	-0.0014	-0.0013
	(0.0200)	(0.0037)	(0.0036)
Volatility % Change - Past 30 days	0.0036***	-0.0008***	-0.0008***
	(0.0010)	(0.0002)	(0.0002)
Volatility Spread	-0.0025**	0.0004***	0.0003***
	(0.0012)	(0.0001)	(0.0001)
Volatility Skew	-0.0022	0.0006	0.0006
	(0.0023)	(0.0005)	(0.0004)
Call Volatility Smirk (ATM - OTM)	-0.0019	0.0005*	0.0005**
	(0.0017)	(0.0003)	(0.0003)
Call Volatility Smirk (ITM - OTM)	-0.0027	0.0009	0.0008
	(0.0039)	(0.0007)	(0.0007)
Put Volatility Smirk (ATM - OTM)	0.0021	-0.0006	-0.0006
	(0.0024)	(0.0005)	(0.0005)
Put Volatility Smirk (ITM - OTM)	0.0053	-0.0013**	-0.0013**
	(0.0036)	(0.0007)	(0.0006)

Table 2-4 Univariate Analysis – Unexpected Turnovers on Put Options against Volatility Measures and Price Discrepancy Measures

	Explanatory Variables		
Dependent Variables	OLS Residual	OC1	OC2
Percentage Change in VIX	0.0406***	-0.0056***	-0.0053***
	(0.0157)	(0.0021)	(0.0020)
Past 30 days realized volatility	0.0289	-0.0018	-0.0017
	(0.0212)	(0.0033)	(0.0031)
Volatility % Change - Past 30 days	0.0053***	-0.0008***	-0.0008***
	(0.0011)	(0.0001)	(0.0001)

Table 2-4—*Continued*

	Explanatory Variables		
Dependent Variables	OLS Residual	OC1	OC2
Volatility Spread	-0.0012	0.0002*	0.0002*
	(0.0009)	(0.0001)	(0.0001)
Volatility Skew	-0.0017	0.0009**	0.0009**
	(0.0027)	(0.0004)	(0.0004)
Call Volatility Smirk (ATM - OTM)	-0.0026	0.0008***	0.0008***
	(0.0021)	(0.0002)	(0.0002)
Call Volatility Smirk (ITM - OTM)	-0.0040	0.0016***	0.0015***
	(0.0048)	(0.0006)	(0.0006)
Put Volatility Smirk (ATM - OTM)	0.0013	-0.0010**	-0.0009**
	(0.0030)	(0.0004)	(0.0004)
Put Volatility Smirk (ITM - OTM)	0.0050	-0.0018***	-0.0017***
	(0.0045)	(0.0006)	(0.0006)

To further explore above findings, I divide all sample firms into two groups according to percentage of institutional holdings of the firm. The sample firms are sorted into two portfolios with the cutoff point set at the median percentage of institutional holdings of the entire sample. This sorting then makes each group has virtually equal number of firms. As explained in Chapter 1, institutional investors are less likely subject to behavioral biases. If any of the patterns is more pronounced in the group with lower institutional ownership, the pattern is more likely due to behavioral biases, such as investor overconfidence. By comparing Panel A and Panel B in Table 2.5, I find very similar results in most of tests except the one for volatility spread. All trading measures have no explanatory power on volatility spread for the group with higher institutional ownership, while they appear to be highly correlated with volatility spread for the group with lower institutional ownership. Again, OLS residuals are negatively correlated with volatility spread in this table, while OC1/OC2 are positively correlated with volatility spread. Given volatility spread is dominated by the relative demand on ATM call options

to that on put options, one may conclude that OLS residuals capture demands on put options while OC1/OC2 capture demands on call options.

Table 2-5 Measures – Unexpected Turnovers on All Options against Volatility Measures and Price Discrepancy Sorted by Institutional Ownership

Panel A: High Institutional Ownership

	Explanatory Variables		
Dependent Variables	OLS Residual	OC1	OC2
Percentage Change in VIX	1.4638	-0.3828**	-0.3653**
	(1.4622)	(0.1949)	(0.1848)
Past 30 days realized volatility	-0.0008	0.0006	0.0006
	(0.0200)	(0.0030)	(0.0028)
Volatility % Change - Past 30 days	0.4590***	-0.0740***	-0.0704***
	(0.1090)	(0.0197)	(0.0186)
Volatility Spread	0.0674	-0.0022	-0.0021
	(0.0456)	(0.0060)	(0.0057)
Volatility Skew	-0.3179	0.0719*	0.0686*
	(0.2778)	(0.0398)	(0.0378)
Call Volatility Smirk (ATM - OTM)	-0.3389*	0.0636***	0.0606***
	(0.1805)	(0.0229)	(0.0217)
Call Volatility Smirk (ITM - OTM)	-0.0062	0.0012**	0.0012**
	(0.0041)	(0.0006)	(0.0005)
Put Volatility Smirk (ATM - OTM)	0.3506	-0.0782**	-0.0746**
	(0.2586)	(0.0362)	(0.0344)
Put Volatility Smirk (ITM - OTM)	0.0076*	-0.0016***	-0.0016***
	(0.0040)	(0.0006)	(0.0005)

Panel B: Low Institutional Ownership

	Explanatory Variables		
Dependent Variables	OLS Residual	OC1	OC2
Percentage Change in VIX	1.5253	-0.4060**	-0.3833**
	(1.4289)	(0.1781)	(0.1670)
Past 30 days realized volatility	0.0317*	-0.0036	-0.0034
	(0.0190)	(0.0029)	(0.0027)
Volatility % Change - Past 30 days	0.4071***	-0.0647***	-0.0607***
	(0.1063)	(0.0144)	(0.0136)

Table 2-5—*Continued*

	Explanatory Variables		
Dependent Variables	OLS Residual	OC1	OC2
Volatility Spread	-0.3161**	0.0356***	0.0332***
	(0.1479)	(0.0133)	(0.0124)
Volatility Skew	-0.3141	0.0746*	0.0703*
	(0.2449)	(0.0414)	(0.0388)
Call Volatility Smirk (ATM - OTM)	-0.2928*	0.0603***	0.0568***
	(0.1736)	(0.0212)	(0.0199)
Call Volatility Smirk (ITM - OTM)	-0.0045	0.0011*	0.0011*
	(0.0040)	(0.0006)	(0.0005)
Put Volatility Smirk (ATM - OTM)	0.2967	-0.0809**	-0.0762**
	(0.2488)	(0.0403)	(0.0378)
Put Volatility Smirk (ITM - OTM)	0.0063*	-0.0014**	-0.0013**
	(0.0036)	(0.0006)	(0.0005)

2.4.2 Cross-Sectional Analysis

As suggested both in Cremers and Weinbaum (2010) and in Xing, Zhang, and Zhao (2010), differences in implied volatility may predict future equity returns. While informed traders, as shown in both studies, may well be the driven force in the findings, I would like to explore if there is any other alternative explanation. Option turnover ratios, unlike some of the demand based trading activity measure used in studies such as Pan and Poteshman (2006), are publicly available information. It would be difficult to argue informed traders are fully accountable for the predictability of volatility spread/skew/smirk, if the volatility patterns are directly tied to observable trading activities. Therefore, I conduct a set of simple tests to examine whether or not there is a cross-sectional connection between volatility patterns and trading activities.

Table 2-6 Cross-Sectional Analyses – Trading Activities against Price Discrepancy Measures

Panel A: All Option Turnover

Variables	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0060	-0.0069	-0.0068	-0.0074	-0.0072	-0.0078	-0.0078	-0.0080	-0.0086	-0.0091	-0.0031	-6.08
IV_SKEW	0.0460	0.0466	0.0448	0.0441	0.0433	0.0433	0.0430	0.0449	0.0454	0.0489	0.0029	0.93
SMIRK_C_OA	0.0020	0.0044	0.0061	0.0071	0.0073	0.0083	0.0089	0.0085	0.0091	0.0092	0.0071	3.44
SMIRK_C_OI	0.0311	0.0328	0.0324	0.0337	0.0332	0.0344	0.0352	0.0360	0.0371	0.0392	0.0082	2.47
SMIRK_P_OA	-0.0327	-0.0355	-0.0345	-0.0343	-0.0340	-0.0341	-0.0341	-0.0349	-0.0358	-0.0365	-0.0038	-1.28
SMIRK_P_OI	-0.0254	-0.0292	-0.0289	-0.0301	-0.0312	-0.0327	-0.0333	-0.0344	-0.0350	-0.0362	-0.0108	-2.96
Return	-0.0079	-0.0014	0.0018	0.0053	0.0081	0.0112	0.0137	0.0175	0.0210	0.0319	0.0398	5.60
Future_Return	0.0133	0.0114	0.0105	0.0093	0.0102	0.0097	0.0088	0.0093	0.0089	0.0078	-0.0056	-0.83

Panel B: Call Option Turnover

Variables	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0060	-0.0068	-0.0070	-0.0071	-0.0075	-0.0077	-0.0079	-0.0081	-0.0083	-0.0092	-0.0032	-6.18
IV_SKEW	0.0500	0.0458	0.0452	0.0443	0.0444	0.0443	0.0440	0.0435	0.0454	0.0472	-0.0028	-0.83
SMIRK_C_OA	0.0038	0.0056	0.0060	0.0073	0.0076	0.0082	0.0086	0.0088	0.0085	0.0086	0.0048	2.22
SMIRK_C_OI	0.0313	0.0327	0.0337	0.0335	0.0340	0.0344	0.0354	0.0358	0.0371	0.0379	0.0065	1.88
SMIRK_P_OA	-0.0323	-0.0352	-0.0355	-0.0343	-0.0343	-0.0346	-0.0351	-0.0344	-0.0356	-0.0352	-0.0029	-0.96
SMIRK_P_OI	-0.0249	-0.0286	-0.0279	-0.0312	-0.0321	-0.0331	-0.0336	-0.0345	-0.0355	-0.0344	-0.0095	-2.88
Return	-0.0140	-0.0065	-0.0024	0.0014	0.0059	0.0097	0.0147	0.0203	0.0273	0.0450	0.0590	8.49
Future_Return	0.0128	0.0105	0.0099	0.0095	0.0110	0.0102	0.0094	0.0087	0.0089	0.0081	-0.0047	-0.69

Panel C: Put Option Turnover

Variables	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0055	-0.0070	-0.0073	-0.0077	-0.0076	-0.0077	-0.0079	-0.0081	-0.0084	-0.0082	-0.0027	-5.27
IV_SKEW	0.0428	0.0456	0.0437	0.0437	0.0425	0.0425	0.0435	0.0448	0.0472	0.0502	0.0074	2.44
SMIRK_C_OA	0.0005	0.0041	0.0054	0.0069	0.0074	0.0081	0.0082	0.0095	0.0103	0.0102	0.0097	5.34
SMIRK_C_OI	0.0293	0.0321	0.0325	0.0326	0.0337	0.0345	0.0354	0.0363	0.0382	0.0404	0.0111	3.77
SMIRK_P_OA	-0.0360	-0.0343	-0.0330	-0.0332	-0.0330	-0.0341	-0.0342	-0.0356	-0.0363	-0.0380	-0.0020	-0.71
SMIRK_P_OI	-0.0268	-0.0285	-0.0288	-0.0298	-0.0307	-0.0322	-0.0329	-0.0343	-0.0351	-0.0386	-0.0118	-3.01
Return	0.0081	0.0110	0.0130	0.0119	0.0110	0.0128	0.0128	0.0087	0.0067	0.0051	-0.0029	-0.43
Future_Return	0.0128	0.0117	0.0105	0.0112	0.0095	0.0091	0.0086	0.0090	0.0085	0.0081	-0.0048	-0.72

Table 2-6—*Continued*

Panel D: O/S Ratio (in number of shares)

Variables	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0036	-0.0042	-0.0051	-0.0056	-0.0063	-0.0070	-0.0082	-0.0089	-0.0102	-0.0153	-0.0117	-18.27
IV_SKEW	0.0396	0.0429	0.0433	0.0425	0.0428	0.0432	0.0428	0.0432	0.0446	0.0519	0.0123	2.60
SMIRK_C_OA	-0.0023	0.0044	0.0043	0.0051	0.0067	0.0069	0.0080	0.0087	0.0093	0.0105	0.0128	4.01
SMIRK_C_OI	0.0226	0.0333	0.0304	0.0316	0.0316	0.0324	0.0338	0.0359	0.0380	0.0421	0.0194	4.33
SMIRK_P_OA	-0.0251	-0.0334	-0.0361	-0.0312	-0.0335	-0.0337	-0.0338	-0.0343	-0.0352	-0.0383	-0.0132	-2.23
SMIRK_P_OI	-0.0266	-0.0215	-0.0237	-0.0282	-0.0285	-0.0302	-0.0315	-0.0338	-0.0356	-0.0384	-0.0118	-2.36
Return	-0.0004	0.0056	0.0076	0.0098	0.0100	0.0106	0.0136	0.0139	0.0147	0.0157	0.0161	2.51
Future_Return	0.0138	0.0119	0.0128	0.0105	0.0104	0.0091	0.0097	0.0085	0.0080	0.0045	-0.0093	-1.43

Panel E: O/S Ratio (in dollar value)

Variables	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0043	-0.0045	-0.0049	-0.0056	-0.0060	-0.0064	-0.0073	-0.0083	-0.0091	-0.0186	-0.0144	-17.31
IV_SKEW	0.0397	0.0404	0.0400	0.0408	0.0402	0.0412	0.0417	0.0428	0.0455	0.0604	0.0206	4.96
SMIRK_C_OA	0.0025	0.0045	0.0060	0.0069	0.0074	0.0083	0.0082	0.0094	0.0090	0.0083	0.0059	3.02
SMIRK_C_OI	0.0262	0.0295	0.0291	0.0306	0.0306	0.0328	0.0349	0.0373	0.0391	0.0434	0.0172	4.59
SMIRK_P_OA	-0.0282	-0.0306	-0.0321	-0.0299	-0.0315	-0.0329	-0.0333	-0.0344	-0.0369	-0.0423	-0.0141	-3.29
SMIRK_P_OI	-0.0196	-0.0249	-0.0239	-0.0274	-0.0289	-0.0303	-0.0331	-0.0355	-0.0367	-0.0376	-0.0179	-4.03
Return	0.0024	0.0052	0.0072	0.0096	0.0110	0.0109	0.0129	0.0135	0.0154	0.0128	0.0105	1.42
Future_Return	0.0123	0.0099	0.0112	0.0118	0.0109	0.0094	0.0095	0.0108	0.0085	0.0049	-0.0074	-1.07

First, I sort all the sample firms into deciles based on monthly average trading turnover, and calculate the volatility patterns for each decile. All the volatility patterns for each decile are weighted based on open interests. In Table 2.6, I use a variety of trading measures, including option turnover, call option turnover, put option turnover, O/S ratio, and O/S ratio in dollar value. Regardless of which trading measure is used, we may observe a virtually monotonic pattern on volatility spread across trading deciles, where more heavily traded portfolios have more negative volatility spread. Also, the differences of volatility spread between the most and the least active portfolios are statistically significant across all measures. In addition to volatility spread, I also find a pattern that option traders tend to be more active on stocks with better performance during the same time span. *Return* variable is monthly return during the same month when firms are sorted based on trading turnover. This phenomenon is especially found with trading on call options. In both Panel A and B, I find the difference of concurrent returns between the highest trading turnover decile and the lowest one is statistically significant, where portfolio with highest trading turnover earns better returns. This suggests option traders tend to chase “hot” firms in the options market. According to above findings, one may conclude that option traders are more active when volatility spread is low and underlying stock performs well. However, the subsequent returns on the portfolios with more active trading activities are not better. *Future_Return* is the raw monthly return over next calendar month for the same portfolio, while *Adj_Return* is the next month return adjusted for Fama-French three factors. Both measures show decreasing trend from the lowest trading decile to the highest one, while the difference between the top and bottom deciles is not statistically significant.

If one takes a closer look across three panels in Table 2.6, one may find the clear pattern of more active trading associated with better concurrent equity returns is mainly

driven by call option traders. The pattern appears in Panel A and B but not in C. Two implications may be derived from this finding. First, it is consistent with general expectation that put options is used for hedging and therefore the trading activities of put options are not correlated with recent equity performance. Second, it supports investor overconfidence hypothesis in that call option traders are more active when underlying equities are performing well on average. Note that in this analysis I am not running the same type of tests as in Chapter 1, but instead I am examining the characteristics of heavily trading options. The positive relationship between trading turnover and underlying stock returns is less likely because of informed trading. If it is the case, we should observe the negative relationship in Panel C. Given short-sell constraint is more of an issue in equity market, investors who hold private information and look bad on the future performance of certain stocks should tend to take advantage in put options market. However, this does not appear to be the case. It is rather difficult to argue this finding captures investors' accurate forecasts, if this pattern only applies on call option trading. If call options are used for conducting momentum or contrarian strategies, the pattern does not reconcile with negative (but insignificant) relationship between trading turnover and future returns. Consequently, the finding makes investor overconfidence a more plausible explanation. Another candidate explanation is disposition effect. If investors tend to holding on to their losing stakes while liquidating winning ones, the supply of in-the-money options may increase while that of out-of-the-money options decreases. The phenomenon should lead to less expansive ITM call options and more expansive OTM call options. Again, it does not appear to be the case, as *SMIRK_C_OA* and *SMIRK_C_OI* are positively correlated with trading turnover. These two variables measure the relative expensiveness between ATM/ITM options and OTM options, and larger figures mean more expensive ATM/ITM options relative to OTM ones. Therefore,

the figures tell that heavily traded call options generally have more expensive ATM/ITM options relative to OTM options. This does not agree with disposition effect hypothesis.

It is worthy to note that put option turnover and O/S ratio are positively correlated with implied volatility skew (*IV_SKEW*), which is consistent with the argument that investors tend to utilize out-of-the-money put options to protect their investments in underlying equity market and therefore make OTM put options more expensive.

Although this study does not rebalance portfolios in the way similar to Cremers and Weinbaum (2010) and Xing et al. (2010), I would also take a look on the predictability of implied volatility spread (*VS*) and implied volatility skew (*IV_SKEW*) to future stock performance. Panel A, B, C do not show any significant patterns in terms of future stock returns, despite of significant pattern found in *VS*. Nevertheless, Panel D and E show certain predictability on future equity performance, especially when I account for Fama-French three factors. In Panel D, O/S ratio in number of shares is used to capture option trading activities. O/S ration is negatively and significantly correlated with *VS*, and also negatively correlated with future stock returns. The findings suggest that when options market is more active than its underlying equity market, the underlying equity tends to have worse performance in the future. This is consistent with what was found in Cremers and Weinbaum (2010) and in Xing et al. (2010). However, the direct connection between O/S ratio and future equity returns may suggests options market reveals better information than does underlying equity market. In addition, even though we still find a tendency of option investors pursuing stocks with higher concurrent returns, it is not as strong as in Panel B. The same finding is also documented in Panel E. Assume investors are generally active in both options and equity markets but shift their focus from time to time. O/S ratio may be considered as a measure of their relative focus on either market, where higher O/S means that they focus more on options market. Under this assumption,

an implication can be derived from above findings. Since more active options market predicts worse future equity returns, we may conclude that options market reacts faster to negative signals. This does not contradict with the discussion in Panel A through C, where I find option traders might have hard time processing positive signals as indicated by stronger recent performance.

There are two potential factors that could be driving the findings above, including underlying risks and liquidity. To examine whether these factors explain the findings above, Table 2.7 summarizes a similar analysis but controls for these factors. I first run time-series regressions on option turnovers and O/S ratios against return volatility of the underlying equity, proportional effective spread of options, and illiquidity measure[12] proposed by Amihud (2002) for each sample firms, and then extract residuals from the regressions. Then I sort the sample into deciles according to excess trading activities, which are captured by OLS residuals. At the first sight, all five measures have less explanatory power cross-sectionally on volatility patterns, except for volatility spread. Again, O/S ratios are positively correlated with volatility skew. However, the predictability of O/S ratios is consumed by the control variables. It is intuitive to argue that the shift from equity market to options market is due to liquidity in corresponding markets, especially when it comes to the process of negative information. Again, it might be relative difficult to price negative information efficiently in equity market than in options market. The illiquidity measures in both markets may well account for the difference and therefore consume the predictability. However, the finding that call option traders pursue "hot" stocks but do not predict future performance in underlying equity market remain intact despite of less significant results.

[12] According to Gopalan et al. (2012), this measure is highly skewed, and is taken square root in this study. The adjusting method can be referred to Gopalan et al. (2012) on page 342.

Table 2-7 Cross-Sectional Analyses – Excess Trading Activities against Price Discrepancy Measures

Panel A: All Option Turnover

Variables	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0065	-0.0065	-0.0065	-0.0066	-0.0065	-0.0066	-0.0067	-0.0068	-0.0070	-0.0073	-0.0008	-1.75
IV_SKEW	0.0432	0.0418	0.0427	0.0416	0.0414	0.0423	0.0418	0.0416	0.0427	0.0450	0.0017	0.67
SMIRK_C_OA	0.0104	0.0092	0.0089	0.0097	0.0092	0.0089	0.0089	0.0092	0.0090	0.0086	-0.0018	-1.11
SMIRK_C_OI	0.0366	0.0357	0.0367	0.0357	0.0353	0.0359	0.0359	0.0351	0.0366	0.0371	0.0005	0.17
SMIRK_P_OA	-0.0340	-0.0330	-0.0352	-0.0338	-0.0341	-0.0346	-0.0343	-0.0337	-0.0343	-0.0354	-0.0014	-0.63
SMIRK_P_OI	-0.0327	-0.0348	-0.0346	-0.0345	-0.0354	-0.0339	-0.0342	-0.0338	-0.0340	-0.0330	-0.0003	-0.09
Return	0.0083	0.0067	0.0057	0.0082	0.0085	0.0085	0.0125	0.0149	0.0169	0.0237	0.0154	2.30
Future_Return	0.0130	0.0116	0.0101	0.0117	0.0109	0.0122	0.0105	0.0101	0.0118	0.0102	-0.0028	-0.45

Panel B: Call Option Turnover

Variables	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0066	-0.0067	-0.0067	-0.0064	-0.0067	-0.0065	-0.0066	-0.0066	-0.0070	-0.0072	-0.0006	-1.30
IV_SKEW	0.0419	0.0432	0.0413	0.0428	0.0431	0.0424	0.0417	0.0423	0.0426	0.0434	0.0015	0.61
SMIRK_C_OA	0.0107	0.0098	0.0099	0.0092	0.0096	0.0092	0.0087	0.0088	0.0084	0.0082	-0.0026	-1.63
SMIRK_C_OI	0.0369	0.0355	0.0361	0.0356	0.0366	0.0364	0.0362	0.0358	0.0359	0.0359	-0.0010	-0.31
SMIRK_P_OA	-0.0327	-0.0338	-0.0341	-0.0344	-0.0354	-0.0354	-0.0346	-0.0342	-0.0342	-0.0339	-0.0012	-0.54
SMIRK_P_OI	-0.0328	-0.0324	-0.0345	-0.0353	-0.0353	-0.0353	-0.0347	-0.0339	-0.0343	-0.0316	0.0012	0.34
Return	0.0057	0.0041	0.0050	0.0051	0.0057	0.0085	0.0126	0.0135	0.0224	0.0316	0.0259	3.99
Future_Return	0.0129	0.0108	0.0110	0.0099	0.0111	0.0117	0.0117	0.0102	0.0132	0.0096	-0.0033	-0.55

Panel C: Put Option Turnover

Variables	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0054	-0.0067	-0.0066	-0.0068	-0.0068	-0.0068	-0.0067	-0.0073	-0.0071	-0.0072	-0.0018	-5.13
IV_SKEW	0.0460	0.0433	0.0417	0.0416	0.0410	0.0406	0.0411	0.0413	0.0430	0.0468	0.0008	1.18
SMIRK_C_OA	0.0078	0.0088	0.0085	0.0084	0.0087	0.0091	0.0095	0.0102	0.0098	0.0106	0.0028	2.20
SMIRK_C_OI	0.0345	0.0358	0.0355	0.0346	0.0359	0.0355	0.0360	0.0362	0.0368	0.0390	0.0045	1.93
SMIRK_P_OA	-0.0354	-0.0349	-0.0336	-0.0336	-0.0337	-0.0331	-0.0339	-0.0337	-0.0350	-0.0369	-0.0015	-0.67
SMIRK_P_OI	-0.0330	-0.0334	-0.0348	-0.0338	-0.0347	-0.0341	-0.0343	-0.0339	-0.0332	-0.0358	-0.0028	-0.62
Return	0.0159	0.0174	0.0149	0.0132	0.0122	0.0132	0.0077	0.0098	0.0047	0.0035	-0.0124	-1.84
Future_Return	0.0143	0.0131	0.0107	0.0120	0.0112	0.0094	0.0098	0.0102	0.0102	0.0107	-0.0037	-0.59

Table 2-7—*Continued*

Panel D: O/S Ratio (in number of shares)

Variables	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0075	-0.0063	-0.0056	-0.0057	-0.0050	-0.0055	-0.0061	-0.0068	-0.0073	-0.0111	-0.0035	-6.84
IV_SKEW	0.0387	0.0391	0.0381	0.0406	0.0410	0.0434	0.0429	0.0448	0.0450	0.0495	0.0108	4.35
SMIRK_C_OA	0.0108	0.0098	0.0090	0.0091	0.0076	0.0083	0.0077	0.0085	0.0095	0.0100	-0.0008	-0.52
SMIRK_C_OI	0.0364	0.0348	0.0350	0.0348	0.0344	0.0336	0.0334	0.0355	0.0379	0.0411	0.0047	1.41
SMIRK_P_OA	-0.0317	-0.0316	-0.0312	-0.0332	-0.0337	-0.0347	-0.0344	-0.0362	-0.0367	-0.0392	-0.0075	-3.38
SMIRK_P_OI	-0.0341	-0.0336	-0.0319	-0.0317	-0.0340	-0.0322	-0.0333	-0.0331	-0.0363	-0.0387	-0.0046	-1.47
Return	0.0125	0.0135	0.0098	0.0087	0.0078	0.0097	0.0109	0.0121	0.0130	0.0157	0.0031	0.49
Future_Return	0.0136	0.0134	0.0133	0.0120	0.0116	0.0096	0.0088	0.0095	0.0087	0.0117	-0.0019	-0.29

Panel E: O/S Ratio (in dollar value)

Variables	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0082	-0.0064	-0.0058	-0.0055	-0.0049	-0.0051	-0.0058	-0.0063	-0.0072	-0.0117	-0.0035	-5.44
IV_SKEW	0.0414	0.0391	0.0388	0.0395	0.0397	0.0405	0.0421	0.0429	0.0442	0.0530	0.0116	4.23
SMIRK_C_OA	0.0105	0.0092	0.0096	0.0093	0.0091	0.0081	0.0075	0.0081	0.0093	0.0098	-0.0007	-0.44
SMIRK_C_OI	0.0376	0.0355	0.0345	0.0337	0.0339	0.0317	0.0333	0.0353	0.0382	0.0427	0.0050	1.40
SMIRK_P_OA	-0.0341	-0.0314	-0.0323	-0.0326	-0.0324	-0.0324	-0.0324	-0.0346	-0.0369	-0.0414	-0.0072	-2.98
SMIRK_P_OI	-0.0359	-0.0347	-0.0341	-0.0328	-0.0318	-0.0298	-0.0315	-0.0329	-0.0355	-0.0386	-0.0027	-0.78
Return	0.0161	0.0123	0.0102	0.0098	0.0094	0.0086	0.0107	0.0122	0.0123	0.0121	-0.0039	-0.52
Future_Return	0.0140	0.0126	0.0126	0.0113	0.0108	0.0096	0.0092	0.0102	0.0101	0.0116	-0.0024	-0.35

In sum, Table 2.6 and 2.7 generally support investor overconfidence hypothesis. Although I also find some evidence supporting informed trading, it is more likely due to liquidity in both underlying equity market and options market.

To further investigate the role of liquidity in options trading, I do a double sorting in Table 2.8 to further explore the potential influence of liquidity in options market to volatility patterns. In Easley et al. (1998), their model suggests informed traders are more likely to trade in options market when the liquidity of options market are high. Interestingly, after controlling for liquidity, option turnover only explains differences in volatility spread but not so much to volatility smirk. On the other hand, I find options with higher liquidity tend to have higher volatility spread and higher volatility skew. It is widely accepted that informed traders may actively trade on put options due to short sale constraints. The finding that higher volatility skew comes along with higher liquidity in both Panel A and Panel B supports the argument. It is rather confusing to see positive correlation between liquidity and volatility spread, controlling for option turnover, as volatility spread and volatility skew predict the opposite direction of future stock returns. In Panel B when O/S ratio is used as trading measure, the results from volatility spread and volatility skew reconcile with each other, especially for firms with more heavily traded options. This finding is consistent with Roll, Schwartz, and Subramanyam (2010) who argue O/S is an indicator of informed trading. However, it is even more interesting to see the relative expensiveness between ATM and OTM call options in Panel B. OTM call options are more expensive for firms with higher O/S ratio and with more liquid options. Consistent with investor overconfidence theory, OTM call options become more expensive when overconfident agents create higher demand on them. This may be worthy for further exploration.

Table 2-8 Cross-Sectional Analyses – Double Sorting by Trading Activities and Liquidity Measure

Panel A: Option Turnover as Trading Measure

Section1: Volatility Spread

		Option Turnover						
		1	**2**	**3**	**4**	**5**	**Diff**	**t-stat**
Liquidity	**1**	-0.0046	-0.0050	-0.0058	-0.0055	-0.0074	-0.0028	-3.15
	2	-0.0072	-0.0072	-0.0074	-0.0076	-0.0078	-0.0005	-0.86
	3	-0.0074	-0.0082	-0.0085	-0.0086	-0.0095	-0.0022	-3.42
	4	-0.0073	-0.0080	-0.0080	-0.0089	-0.0095	-0.0022	-4.16
	5	-0.0088	-0.0077	-0.0074	-0.0080	-0.0090	-0.0002	-0.18
	Diff	-0.0042	-0.0027	-0.0017	-0.0025	-0.0016		
	t-stat	-4.40	-4.46	-3.14	-4.39	-1.98		

Section 2: Volatility Skew

		Option Turnover						
		1	**2**	**3**	**4**	**5**	**Diff**	**t-stat**
Liquidity	**1**	0.0585	0.0622	0.0567	0.0581	0.0676	0.0090	1.36
	2	0.0512	0.0489	0.0485	0.0498	0.0544	0.0031	0.92
	3	0.0428	0.0454	0.0457	0.0465	0.0499	0.0072	2.57
	4	0.0436	0.0413	0.0414	0.0432	0.0466	0.0030	1.10
	5	0.0401	0.0382	0.0380	0.0395	0.0427	0.0026	1.04
	Diff	-0.0185	-0.0240	-0.0187	-0.0186	-0.0249		
	t-stat	-3.73	-6.83	-4.35	-4.05	-4.88		

Section 3: Call Volatility Smirk (ATM - OTM)

		Option Turnover						
		1	**2**	**3**	**4**	**5**	**Diff**	**t-stat**
Liquidity	**1**	-0.0096	-0.0053	-0.0046	-0.0055	-0.0040	0.0056	1.40
	2	0.0035	0.0021	0.0020	0.0018	-0.0001	-0.0036	-1.87
	3	0.0055	0.0077	0.0077	0.0071	0.0057	0.0002	0.11
	4	0.0079	0.0102	0.0106	0.0107	0.0102	0.0023	1.38
	5	0.0126	0.0129	0.0128	0.0132	0.0144	0.0018	1.07
	Diff	0.0222	0.0182	0.0174	0.0187	0.0184		
	t-stat	6.43	7.79	7.03	8.11	6.92		

Table 2-8—*Continued*

Section 4: Call Volatility Smirk (ITM - OTM)

Liquidity	Option Turnover 1	2	3	4	5	Diff	t-stat
1	0.0311	0.0274	0.0245	0.0284	0.0338	0.0027	0.60
2	0.0310	0.0312	0.0280	0.0298	0.0302	-0.0009	-0.28
3	0.0318	0.0324	0.0332	0.0333	0.0328	0.0010	0.34
4	0.0369	0.0342	0.0358	0.0360	0.0380	0.0011	0.33
5	0.0363	0.0370	0.0381	0.0404	0.0437	0.0075	2.08
Diff	0.0052	0.0096	0.0136	0.0120	0.0100		
t-stat	1.37	2.99	3.91	3.16	2.31		

Section 5: Put Volatility Smirk (ATM - OTM)

Liquidity	Option Turnover 1	2	3	4	5	Diff	t-stat
1	-0.0402	-0.0431	-0.0398	-0.0514	-0.0468	-0.0066	-1.02
2	-0.0361	-0.0353	-0.0364	-0.0379	-0.0397	-0.0035	-1.18
3	-0.0343	-0.0351	-0.0346	-0.0345	-0.0363	-0.0020	-0.85
4	-0.0357	-0.0330	-0.0332	-0.0327	-0.0357	0.0000	0.01
5	-0.0306	-0.0311	-0.0319	-0.0325	-0.0349	-0.0044	-1.70
Diff	0.0096	0.0121	0.0080	0.0189	0.0118		
t-stat	1.81	3.67	2.03	4.48	2.66		

Section 6: Put Volatility Smirk (ITM - OTM)

Liquidity	Option Turnover 1	2	3	4	5	Diff	t-stat
1	-0.0207	-0.0184	-0.0232	-0.0278	-0.0275	-0.0069	-0.82
2	-0.0226	-0.0247	-0.0229	-0.0242	-0.0195	0.0031	0.61
3	-0.0281	-0.0279	-0.0302	-0.0301	-0.0290	-0.0009	-0.32
4	-0.0364	-0.0328	-0.0337	-0.0332	-0.0353	0.0011	3.42
5	-0.0370	-0.0344	-0.0363	-0.0396	-0.0427	-0.0057	-1.47
Diff	-0.0163	-0.0160	-0.0132	-0.0118	-0.0151		
t-stat	-2.45	-3.98	-2.63	-1.97	-2.39		

Table 2-8—*Continued*

Panel B: O/S Ratio as Trading Measure

Section1: Volatility Spread

		O/S Ratio						
		1	**2**	**3**	**4**	**5**	**Diff**	**t-stat**
Liquidity	**1**	-0.0032	-0.0048	-0.0067	-0.0121	-0.0211	-0.0179	-7.99
	2	-0.0046	-0.0053	-0.0071	-0.0105	-0.0200	-0.0155	-12.96
	3	-0.0044	-0.0055	-0.0068	-0.0097	-0.0186	-0.0142	-13.62
	4	-0.0044	-0.0056	-0.0067	-0.0081	-0.0141	-0.0097	-12.85
	5	-0.0042	-0.0059	-0.0066	-0.0075	-0.0100	-0.0058	-4.74
	Diff	-0.0010	-0.0011	0.0001	0.0045	0.0111		
	t-stat	-0.86	-1.94	0.18	4.48	4.96		

Section 2: Volatility Skew

		O/S Ratio						
		1	**2**	**3**	**4**	**5**	**Diff**	**t-stat**
Liquidity	**1**	0.0541	0.0510	0.0606	0.0660	0.0878	0.0337	4.44
	2	0.0446	0.0446	0.0476	0.0530	0.0652	0.0206	5.11
	3	0.0410	0.0438	0.0428	0.0454	0.0586	0.0176	4.17
	4	0.0370	0.0378	0.0398	0.0416	0.0498	0.0128	2.88
	5	0.0300	0.0365	0.0360	0.0378	0.0425	0.0125	2.31
	Diff	-0.0241	-0.0145	-0.0246	-0.0282	-0.0453		
	t-stat	-3.58	-3.69	-7.55	-5.53	-7.01		

Section 3: Call Volatility Smirk (ATM - OTM)

		O/S Ratio						
		1	**2**	**3**	**4**	**5**	**Diff**	**t-stat**
Liquidity	**1**	-0.0048	-0.0025	-0.0024	-0.0060	-0.0195	-0.0147	-2.89
	2	0.0033	0.0029	0.0022	0.0026	-0.0014	-0.0046	-2.02
	3	0.0071	0.0068	0.0074	0.0073	0.0051	-0.0020	-0.94
	4	0.0084	0.0088	0.0099	0.0107	0.0104	0.0019	0.98
	5	0.0066	0.0095	0.0120	0.0124	0.0145	0.0079	1.14
	Diff	0.0114	0.0120	0.0145	0.0184	0.0340		
	t-stat	1.50	4.09	6.42	6.45	8.66		

Table 2-8—*Continued*

Section 4: Call Volatility Smirk (ITM - OTM)

Liquidity \ O/S Ratio	1	2	3	4	5	Diff	t-stat
1	0.0340	0.0291	0.0308	0.0283	0.0285	-0.0055	-0.89
2	0.0271	0.0305	0.0298	0.0305	0.0283	0.0013	0.38
3	0.0291	0.0302	0.0321	0.0341	0.0337	0.0045	1.26
4	0.0337	0.0321	0.0340	0.0362	0.0392	0.0055	1.48
5	0.0332	0.0315	0.0321	0.0370	0.0444	0.0113	1.25
Diff	-0.0008	0.0023	0.0014	0.0087	0.0160		
t-stat	-0.09	0.77	0.42	2.24	2.81		

Section 5: Put Volatility Smirk (ATM - OTM)

Liquidity \ O/S Ratio	1	2	3	4	5	Diff	t-stat
1	-0.0370	-0.0490	-0.0459	-0.0433	-0.0419	-0.0049	-0.63
2	-0.0369	-0.0356	-0.0372	-0.0365	-0.0406	-0.0037	-0.94
3	-0.0319	-0.0327	-0.0339	-0.0360	-0.0371	-0.0052	-1.48
4	-0.0282	-0.0285	-0.0310	-0.0337	-0.0366	-0.0083	-2.19
5	-0.0255	-0.0290	-0.0276	-0.0306	-0.0355	-0.0100	-2.39
Diff	0.0115	0.0200	0.0184	0.0127	0.0064		
t-stat	1.87	4.45	5.11	2.75	0.99		

Section 6: Put Volatility Smirk (ITM - OTM)

Liquidity \ O/S Ratio	1	2	3	4	5	Diff	t-stat
1	-0.0272	-0.0269	-0.0259	-0.0179	-0.0047	0.0225	2.36
2	-0.0257	-0.0265	-0.0251	-0.0228	-0.0176	0.0082	1.58
3	-0.0245	-0.0276	-0.0283	-0.0313	-0.0268	-0.0023	-0.52
4	-0.0378	-0.0278	-0.0315	-0.0345	-0.0357	0.0021	0.43
5	-0.0131	-0.0298	-0.0311	-0.0360	-0.0429	-0.0298	-3.10
Diff	0.0141	-0.0029	-0.0052	-0.0181	-0.0382		
t-stat	1.29	-0.69	-1.10	-3.35	-4.77		

2.4.3 Momentum and Contrarian

Some may argue that investors are conducting momentum or contrarian strategies in the options market, so that we observe the findings above. To further investigate this possibility, I sort the sample into deciles based on the past one month return on the underlying equity. If momentum or contrarian strategies are the main driven forces, we should observe a tendency that the top and bottom deciles exhibit more activities while the middle deciles are less active. In other words, the trading activities should present a U-shaped pattern across deciles. I do show the pattern exists in Table 2-9. All five turnover measures (TO_O, TO_C, TO_P, OS, and DOS) exhibit similar patterns, especially O/S ratios. In addition, the current month returns and the one month forward returns reverse from the previous month. That is, the top performers have an average lower rate of returns in the following two months, while the bottom performers have an average higher rate of returns. The findings in Table 2-9 support the contrarian strategies may be one of the reasons in the previous findings. However, the differences between middle deciles and the bottom decile are trivial. For example, the difference in option turnover (TO_O) between the worst performers (portfolio 0) and the decile with lowest turnover rate (portfolio 3) is only about 0.07. On the other hand, the difference in the same measure between top performers (portfolio 9) and the worst performers (portfolio 0) is 0.8671, and the difference is statistically significant. This suggests momentum or contrarian strategies might an explanation to the phenomena, but their contributions may not be as strong. Also, significantly higher trading activities with past top performers further strengthen the investor overconfidence argument in that traders are pursuing “hot” stocks (long or short), but they do not seem to have much success. The following returns show negative relationship with trading activities but the relationship does not have statistical support (differences are not statistically significant).

Table 2-9 Cross-Sectional Analyses – Momentum Portofolios

Variable	0	1	2	3	4	5	6	7	8	9	Diff	t-stat
VS	-0.0073	-0.0065	-0.0067	-0.0068	-0.0070	-0.0070	-0.0071	-0.0076	-0.0083	-0.0116	-0.0043	-6.07
IV_SKEW	0.0551	0.0463	0.0438	0.0418	0.0422	0.0417	0.0424	0.0415	0.0430	0.0505	-0.0045	-1.54
IV_SMIRK_C_OA	0.0045	0.0071	0.0078	0.0084	0.0083	0.0085	0.0088	0.0086	0.0090	0.0075	0.0030	1.69
IV_SMIRK_C_OI	0.0400	0.0362	0.0349	0.0343	0.0343	0.0343	0.0340	0.0342	0.0344	0.0355	-0.0044	-1.26
IV_SMIRK_P_OA	-0.0435	-0.0368	-0.0348	-0.0326	-0.0331	-0.0324	-0.0322	-0.0324	-0.0335	-0.0372	0.0062	2.55
IV_SMIRK_P_OI	-0.0357	-0.0328	-0.0307	-0.0308	-0.0321	-0.0309	-0.0323	-0.0330	-0.0336	-0.0353	0.0004	0.11
Return	0.0121	0.0128	0.0107	0.0104	0.0106	0.0103	0.0105	0.0072	0.0077	0.0085	-0.0036	-0.42
Future_Return	0.0138	0.0127	0.0120	0.0118	0.0100	0.0088	0.0091	0.0068	0.0067	0.0076	-0.0062	-0.73
TO_O	3.6789	3.7161	3.6557	3.6003	3.6092	3.6525	3.7487	3.9153	4.0726	4.5460	0.8671	9.63
TO_C	3.8779	3.8660	3.7970	3.8022	3.8743	3.9382	4.0091	4.2475	4.4557	4.9205	1.0426	6.76
TO_P	3.7581	3.7082	3.7853	3.6492	3.5696	3.5657	3.5870	3.7105	3.8437	4.2072	0.4492	4.59
OS	0.0754	0.0709	0.0671	0.0674	0.0657	0.0693	0.0691	0.0732	0.0776	0.0901	0.0147	5.38
DOS	0.0090	0.0058	0.0051	0.0052	0.0046	0.0052	0.0052	0.0054	0.0061	0.0085	-0.0006	-1.43
CP	4.3839	5.2058	5.0695	5.1324	5.6455	5.6580	6.3074	5.9968	5.8670	6.9154	2.5315	3.74
L1RET	-0.1760	-0.0843	-0.0498	-0.0252	-0.0037	0.0167	0.0388	0.0654	0.1037	0.2215	0.3976	37.75

2.5 Conclusion

This chapter supports the first chapter in examining the relationship between trading activities and the option pricing patterns. If investor overconfidence causes heavier trading activities, the option pricing patterns should be strongly correlated with trading activities. Furthermore, the market volatilities should also be positively correlated with trading activities. I present evidence showing both relationships do exist. The relationships hold over time and cross-sectionally.

The negative relationship between volatility spread and trading activities suggests option traders are contrarians overall. The supporting evidence is also provided by sorting sample into deciles based on past equity returns. However, the findings also suggest the differences in trading activities and volatility spread and volatility skew do not predict future equity returns. My findings in this study disagree with Cremer and Weinbaum (2010) and Xing et al. (2010) in terms of the predictability of volatility spread and volatility skew, and therefore serve as evidence against informed trading or superior information in options market. Instead, my findings support investor overconfidence theory in that option traders also tend to pursue top performers, and also strengthen the argument in the first chapter that the positive relationship between past market return and option trading activities may be due to investor overconfidence.

This study adds to the discussion in the literature in regards of the role played by behavioral biases. While in equity market the debate between efficient market advocates and behavioral finance supporters is still active, this paper extends the scope of the debate to equity options market. The focus in options market does not only provide insights to market speculators trying to exploit opportunities in options market, but also serve as a precaution to investors who heavily hedge their portfolios in equity options market. If behavioral biases play an important role in options market, the effectiveness of

using options to hedge equity portfolio might be degraded. This study shows evidence in supporting the behavioral patterns in options market should draw attentions from the option traders, regardless of their purpose of trading.

References

Alpert, Marc and Howard Raiffa, 1982, “A Progress Report on the Training of Probability Assessors.” *In Judgment under Uncertainty: Heuristics and Biases*, edited by Daniel Kahneman, Paul Slovic, and Amos Tversky, Cambridge: Cambridge Univ. Press.

Amin, K., J.D. Coval, and H.N. Seyhun, 2004, “Index Option Prices and Stock Market Momentum.” *Journal of Business*, 77, 835-873.

Amin, K., C. Lee, 1997, “Option Trading and Earnings New Dissemination.” *Contemporary Accounting Research*, 43, 153-192.

Black, F. and M. Scholes, 1973, “The Pricing of Options and Corporate Liabilities.” *Journal of Political Economics*, 81, 637-654.

Battese, George E. and Tim J. Coelli, 1988, “Prediction of Firm-Level Technical Efficiencies with a Generalized Frontier Production Function and Panel Data”, *Journal of Econometrics*, 38, 387-399.

Camerer, Colin, 1995, “Individual Decision Making,” *The Handbook of Experimental Economics.”* edited by John H. Kagel and Alvin E. Roth. Princeton, N.J.: Princeton Univ. Press.

Cao, C., Z. Chen, and J. M. Griffin, 2005, “Informational Content of Option Volume Prior to Takeovers.” *Journal of Business*, 78, 1073-1109.

Cao, Henry H. and Hui Ou-Yang, 2009, “Differences of Opinion of Public Information and Speculative Trading in Stocks and Options.” *Review of Financial Studies*, 22, 299-335.

Chakravarty, S., H. Hulen, and S. Mayhew, 2004, “Informed Trading in Stock and Option Markets.” *Journal of Finance*, 59, 1235-1257.

Chan, K., Y.P. Chung, and W.M. Fong, 2002, “The Information Role of Stock and Option Volume.” *Review of Financial Studies*, 15, 1049-1075.

Chan, K., Y.P. Chung, and H. Johnson, 1993, “Why Option Prices Lag Stock Prices: A Trading-Based Explanation.” *Journal of Finance*, 48, 1957-1967.

Chordia, T., S.-W. Huh, and A. Subrahmanyam, 2007, “The Cross-section of Expected Trading Activity.” *Review of Financial Studies*, 20, 709-740.

Chordia, T., R. Roll, and A. Subrahmanyam, 2001, “Market Liquidity and Trading Activity”, *Journal of Finance*, 56, 501-530.

Choy, S. K. and Jason Wei, 2012, “Option Trading: Information or Differences of Opinion.” *Journal of Banking and Finance*, forthcoming.

Cox, John C., Stephen A. Ross, and Mark Rubinstein, 1979, “Option Pricing: A Simplified Approach.” *Journal of Financial Economics*, 7, 229-263.

Cremers, M. and D. Weinbaum, 2010, “Deviations from Put-Call Parity and Stock Return Predictability.” *Journal of Quantitative and Financial Analysis*, 45, 335-367.

Daniel K., D. Hirshleifer, and A. Subrahmanyam, 1998, “Investors Psychology and Security Market Under- and Over-Reaction.” *Journal of Finance*, 53, 1839-1885.

Easley, D., M. O’Hara, and P. Srinivas, 1998, “Option Volume and Stock Prices: Evidence on Where Informed Traders Trade.” *Journal of Finance*, 53, 431-465.

Figlewski, S. and G. Webb, 1993, “Options, Short Sales, and Market Completeness.” *Journal of Finance*, 48, 761-777.

Gallant, Ronald A., Peter E. Rossi, and George Tauchen, 1992, “Stock Prices and Volume.” *Review of Financial Studies*, 5, 199-242.

G□rleanu, Nicolae, L. H. Pedersen, and A. M. Poteshman, 2009, “Demand-Based Option Pricing.” *Review of Financial Studies*, 22, 4259-4299.

Gervais, S., and T. Odean, 2001, “Learning to be Overconfident.” *Review of Financial Studies*, 14, 1-27.

Glaser Markus and Martin Weber, 2007, “Overconfidence and Trading Volume.” *Geneva Risk Insurance Review*, 32, 1-36.

Glaser Markus and Martin Weber, 2009, “Which Past Return Affect Trading Volume.” *Journal of Financial Markets*, 12, 1-31.

Griffin, J. M., F. Nardari, and R. M. Stulz, 2007, “Do Investors Trade More When Stocks Have Performed Well? Evidence from 46 Countries.” *Review of Financial Studies*, 20, 905-951.

Gopalan, Radhakrishnan, Ohad Kadan, and Mikhail Pevzner, 2012, “Asset Liquidity and Stock Liquidity”, *Journal of Financial and Quantitative Analysis*, 47, 333-364.

Hayunga, Darren K. and Peter P. Lung, 2010, “Informed Trading in the Option Market Prior to a Revision in Analysts’ Consensus Recommendation.” *working paper*, the University of Texas at Arlington.

Hong, Harrison, José A., Sheinkman, and Wei Xiong, 2006, “Asset Float and Speculative Bubbles.” *Journal of Finance*, 61, 1073-1117.

Jennings, R., L. Starks, 1986, “Earnings Announcements, Stock Price Adjustments, and the Existence of Option Markets.” *Journal of Finance*, 41, 107-125.

Jondrow, James, C.A. Knox Lovell, Ivan S. Materov, and Peter Schmidt, 1982, “On the Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model”, *Journal of Econometrics*, 19, 233-238.

Kim, K. A. and J. R. Nofsinger, 2007, “The Behavior of Individual Investors in Japan during Bull and Bear Markets.” *Journal of Behavioral Finance*, 8, 138-153.

Kyle, Albert S. and Albert F. Wang, 1997, “Speculation Duopoly with Agreement to Disagree: Can Overconfidence Survive the Market Test?” *Journal of Finance*, 52, 2073-2090.

Lakonishok, Josef, Inmoo Lee, Neil D. Pearson, and Allen M. Poteshman, 2007, “Option Market Activity.” *Review of Financial Studies*, 20, 813-857.

Lemmon, M. and Sophie X. Ni, 2011, “The Effects of Investor Sentiment on Speculative Trading and Prices of Stock and Index Options.” *working paper*, the Hong Kong University of Science and Technology.

Lichtenstein, Sarah, B. Fischhoff, and Lawrence D. Phillips, 1982, “Calibration of Probabilities: The State of th Art to 1980.” *In Judgment under Uncertainty: Heuristics and Biases*, edited by Daniel Kahneman, Paul Slovic, and Amos Tversky, Cambridge: Cambridge Univ. Press.

Mendenhall, R. and D. Fehrs, 1999, “Option Listing and the Stock-Price Response to Earnings Announcements.” *Journal of Accounting and Economics*, 27, 57-87.

Muravyev, Dmitriy, Neil D. Pearson, and John P. Broussard, 2012, “Is There Price Discovery in Equity Options?” *Journal of Financial Economics*, forthcoming.

Odean T., 1998a, “Volume, Volatility, Price, and Profit when all Traders are Above Average.” *Journal of Finance*, 53, 1887-1934.

Odean, T., 1998b, “Are Investors Reluctant to Realize Losses?” *Journal of Finance*, 53, 1775-1798.

Pan, Jun and Allen M. Poteshman, 2006, “The Information in Option Volume for Future Stock Prices.” *Review of Financial Studies*, 19, 871-908.

Scheinkman, José A. and Wei Xiong, 2003, “Overconfidence and Speculative Bubbles.” *Journal of Political Economics*, 111, 1183-1220.

Statman, M., S. Thorley, and K. Vorkink, 2006, “Investor Overconfidence and Trading Volume.” *Review of Financial Studies*, 19, 1531-1565.

Stephen, J. A. and R. E. Whaley, 1990, “Intraday Price Change and Trading Volume Relations in the Stock and Stock Option Markets.” *Journal of Finance*, 45, 191-220.

Vijh, A. M., 1990, “Liquidity of the CBOE Equity Options.” *Journal of Finance*, 45, 1157-1179.

Xing, Yuhang, Xiaoyan Zhang, and Rui Zhao, 2010, “What Does the Individual Option Volatility Smirk Tell Us About Future Equity Returns?” *Journal of Financial and Quantitative Analysis*, 45, 641-662.

Biographical Information

Han-Sheng Chen began his pursuance of academic studies in finance in Taiwan, where he earned his undergraduate degree in statistics and M.B.A. in finance. Han-Sheng moved to the United States in 2007 to pursue a doctoral degree in finance. While his master's thesis discusses credit risk in corporate bond market and his doctoral dissertation focuses on investor behaviors in options market, Han-Sheng has a wide scope of interests in academic research, including asset pricing in equity market, risk management, international finance, and executive compensation. He is also interested in working on interdisciplinary studies.

In addition to his dissertation on option trading, Han-Sheng is currently working on several other projects, including volatility across different classes of assets, interactions between option and equity markets under cross-listing context, executive stock option holding and expected stock return, among others.

While academic research always excites Han-Sheng, he also enjoys interactions with students, in or outside of classroom. Han-Sheng got married with Pei-Yi in Taiwan in 2007. He now has a family of four with a boy and a girl born in the United States. Han-Sheng is planning to pursue an academic career with a balanced life among research, teaching, services, and family.