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The Information Flow of Option Markets during Global Financial Crisis: Where Do Informed Traders Trade?

Hongmei Ding and Chien-Ming Huang

Hefei Normal University and Tamkang University

Abstract

Using the original transaction recodes from the Taiwan index options market, this paper is to investigate the trading behaviors of different investors and to capture the information flow between options market and stock market during global financial crisis. In contrast to previous studies, after controlling for the trading volume effects of different exercise prices with the same term-to-expiration, the empirical results show that market investors prefer to trade short-horizon contracts with larger trading liquidity and tend to choose the out-of-the-money options with higher leverage. In addition, there is a significantly reciprocal effect between options market and stock market. When the options trade increases, our findings are also consistent with the pooling equilibrium hypothesis. Particularly, the difference of trades between informed traders and individual investors during global financial crisis has responded to asymmetric information problems. Therefore, this paper concludes that the options trade of foreign institutional investors is more informative, and because of informative advantages, they are probably attracted to out-of-the money options.

Keywords: Options market, global financial crisis, informed traders.

1. Introduction

The informational content of the options market has attracted significant academic attention. Many studies have been devoted to understanding the lead-lag relationship between options market and equity market (e.g., Manaster and Rendleman [19]; Stephen and Whaley [23]; Chan, Chung, and Fong [7], Chan, Chang, and Lung [8]). In particular, a large body of literature has focused on the option trading activities of informed traders (Black [2]; Cherian [12]; Lakonishok, Lee, and Poteshman [17]). In general, if the market is mature and efficient, the transmission of information and the movement of asset prices are rapid. In this case, the derivative securities may be redundant (Black and Scholes [3]).The informed trader, therefore, will tend to trade in the equity market. Otherwise, informed investors will choose to trade derivative commodities to maximize the value of

their private information. Thus, an analysis of the options market may provide important information content.

The number of studies of option trading activity in some emerging markets during recent decades has grown considerably. For example, Grffin, Nardari, and Stulz [15] argue that foreign investors provide more information about the future stock returns in East Asia. Similarly, Richards [21] show that the trading activities of foreign investors have a larger impact on Asian equity markets. In addition, Barber, et al. [1] also document that individual investors in Taiwan experienced large economic losses, but the three major institutional investors often gained more profits from trade. Chang, Hsieh, and Lai [9] following Pan and Poteshman [20], who find option trading volumes contain information about future stock prices, show that the trading volumes of informed traders contain a large amount of information and provide evidence that only foreign institutional investors have a strong predictive power for future stock market returns. They note that the option trading tendency of informed trader may be changed when stock market lies in different market conditions. Moreover, Lakonishok, Lee, and Poteshman [17] also support that different investors hold dissimilar trading motivations. Some investors, for example, can display trend-chasing behavior when the past stock returns are higher, but some investors may tend to short put positions to gain the put premium. Recent study as Chang [10] points out that the option investors' risk preferences and trading motivations have influenced the trading behaviors.

Based on the above-described studies, several questions have been raised in the literature. Firstly, what is the realized trading tendency of informed traders in various listing option contracts? It is important to know the trading space of informed traders because the realized trading tendency may be more informative. Therefore, different trading volumes and different trading contracts must simultaneously be considered in researching process. Secondly, where do informed traders choose to trade? According to the conclusions of Lakonishok, Lee, and Poteshman [17], who notes that the option trading pattern of different investors implies different information content, it is expected that the trading tendency of informed traders may be different for different length terms of expiration. However, these answers have yet to be elucidated. Because trading activities of different terms of expiration can effectively reflect the investors' concerns in the form of price sensitivity, volatility sensitivity, and leveraged effects, this study attempts to capture the realized trading tendency after controlling for the effects of trading volumes and time leverage.

The remainder of this paper is organized as follows. In section 2, which follows, this study reviews the relevant literatures, which include the relationship between option market and stock market, and trading behaviors of options market of informed traders. In section 3, the study describes the data and variables calculations. Section 4 reports the summarize statistics in various investor classes with both different moneyness and different term-to-expiration. Section 5 presents the empirical results and analysis. Finally, the concluding section summarizes our findings and analysis.

2. Literature Review

Although many literatures have examined the relationships between options market and stock markets, the results have been controversial. For example, Stephan and Whaley [23] investigate the intraday relationship between options and stock markets and reported that price changes in the stock market preceded changes in the options market by as much as fifteen minutes. Similar to Stephan and Whaley [23], Vijh [24] argue that the effects of large option trades on stock prices are generally small and that option trades are not informative. In addition, Chan, Chang, and Fong [7] present evidence that the net volume of options trading has no predictive value for contemporaneous and subsequent stock and option quote revisions, thereby implying that trades in the options market do not provide any information about the stock market.

However, some studies present contrary evidence. Manaster and Rendleman [19], for example, investigate whether the information contained in closing option prices could enable investors to earn excess returns. They find that closing option prices contained information that was not reflected in stock prices for up to 24 hours. In other words, option prices will lead stock prices. In addition, Chan, Chung, and Johnson [6] also find no evidence that the stock lead vanishes when the average of bid and ask quotes were considered instead of the transaction price. Easley, OHara, and Srinivas [14] future examine the informational role of transaction volume in options market and noted that the changes in options volumes contain information about future stock prices. They argue that asymmetric information implies that option contracts are not redundant and that put and call options may each affect the behavior of subsequent asset prices. Thus, informed traders probably use options, stocks, or a mixture of the two assets in equilibrium. Consequently, according to their theoretical framework, this enables us to establish a linkage between the two markets and to examine the influence on both markets of options trading among different investor classes.

Trades in options market may contemporaneously affect the stock market trading volumes. Similarly to Easley, OHara, and Srinivas [14], some studies have employed the bivariate vector autoregression (VAR) model to test the lead-lag relationship between options trading value and stock returns. For example, Chen, Lung, and Tay [11] observe the flow of information between the options market and equity market and show that stock returns lead the options trading values. In addition, Chan, Chang, and Lung [8] also use the VAR system to examine the lead-lag relationship between option trading value and stock index returns. Lee and Chen [18] employ the bivariate generalized autoregressive conditional heteroscedasticity (GARCH) model to investigate the transmission of volatility based on option trading volumes and stock market trading volumes. It is found that there are feedback effects within the two markets. More recently, Roll, Schwartz, and Subrahmanyam [22] investigate the determinants of the ratio of the trading volumes of the options and stock markets. The authors argue that the ratio swings dramatically from day to day and relates to many intuitive determinants, such as delta and trading cost. Thus, they conclude that some traders are attempting to exploit what they believe is privileged information.

Consequently, consideration of the variation of unique market activities may cause to ignore the reciprocal effects between the two markets. In fact, one of the great puzzles of finance is the sheer volume of trading. Some of the most active trading occurs among uninformed agents (Roll, Schwartz, Subrahmanyam [22]). From the conclusions of Lakonishok, Lee, and Poteshman [17], covered call strategy result in the popularity of short call option. Thus, the increase in long positions of underlying stocks may go along with the changes in option trades, and the trading volumes of two markets appear contemporaneous. Therefore, the study uses the relative volume ratio between two markets to examine the real effects of the options market on the equity market, to capture the contemporaneous or subsequent relationship, and to investigate the informational content of option trades across different moneynesses and different trader classes.

3. Variables Definition and Empirical Models

The study investigates whether the options trading activities of different investor classes have a significant influence on the stock market and whether the options transaction records provide different information. In next section, the study measures relevant variables, such as stock market returns, volume-weighted average strike price and moneyness of different investor categories, the trading volumes of different investor classes, and the ratio of options market trading volumes to stock markets trading volumes, as described later, are measured.

3.1. Variables definition

3.1.1. Stock market returns and trading volumes

The continue rates of changes of underlying stock returns within fifteen minutes are calculated as the first differences of natural logarithms. It can be interpreted as stock market returns (Cheung et al. [13]). It is as follows.

$$R_t = \log\left(\frac{\textit{Index Price}_t}{\textit{Index Price}_{t-j}}\right) \times 100 \tag{3.1}$$

where the $\textit{Index Price}_t$ is the index price of Taiwan stock exchange (TWSE) at time t, and the $\textit{Index Price}_{t-j}$ is the index price at time $t-j$. The R_t presents the stock market returns at the interval j minutes. According to our interval time, there are altogether 18 observations between 9:00 AM and 13:30 PM every day based on fifteen minutes interval. In the options trading volumes of different investor classes, to reduce the influence of possible outliers the study uses the natural logarithms of options trading volumes of different investor classes and different term-to-expiration.

3.1.2. Volume-weighted average strike price

In the Taiwan's options trading, for listing series of new expiration months or series with new strike price for existing expiration dates, the TAIFEX consecutively introduce series with new strike price based on the closing price of underlying index of previous

business day. In addition, according to the strike price interval above, the highest and lowest strike prices should cover fifteen percent above and below the underlying index for the short-term month and the next two calendar months. Therefore, market investors may trade the contracts of different strike price in the same expiration dates. In the study, to effectively capture the real trading strike price of different investor classes, we use the volume-weighted average strike price instead of the arithmetic average method. It is calculated by

$$VWP_{k,t} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{15} Volume_{k,i,j} \times Strike\ Price_{k,i}}{\sum_{j=1}^{15} Volume_{k,j}} \tag{3.2}$$

where $VWP_{k,t}$ stands for the volume-weighted average strike price of call (put) options the investor class k at interval t. In this study, each interval is fifteen minutes. The $\sum_{j=1}^{15} Volume_{k,j}$ stands for total call (put) options trading volumes of the investor class k at interval fifteen minutes. In addition, the $\sum_{j=1}^{15} Volume_{k,i,j}$ stands for total call (put) options trading volumes of the investor class k in contract i at interval fifteen minutes, and there are n contracts at per interval fifteen minutes. Finally, the $Strike\ Price_{k,i}$ presents strike price of options trade of the investor class k in contract i.

3.1.3. Volume-weighted average moneyness

In the practical and academic researches, moneyness is generally measure that is used to describe the relationship between the options strike price and the price of underlying security or asset. If we define S as the current trading price of the index and let X_i represents the exercise price of options contract i, then the moneyness (M_i) of options contract i can be calculated by

$$M_i = \frac{X_i}{S} \tag{3.3}$$

where M_i of call (put) options is greater (less) than one for out-of-the-money, equal one for at-the-money, and less (greater) than one for in-the-money. Although the M_i can describe the earned returns of options contract i, it does not completely capture the real trading tendency when one trade many options contracts. To overcome the problem, the volume-weighted average moneyness can be calculated as

$$VWM_{k,t} = \frac{VWP_{k,t}}{S} \tag{3.4}$$

where the $VWM_{k,t}$ is the volume-weighted average moneyness of investor classes k at interval t. The $VWP_{k,t}$ is the volume-weighted average strike price. In addition, the measure provides several advantages: one is that the trading sentiment of market investors can be effectively captured. It can be used in observing the real trading price

and intension of different investor classes, which is one of main variables in this study. A simple average moneyness may suffer from measuring bias. Another is that it can also examine whether the effects of asymmetric information exist among different investor classes. From the conclusions of the prior literatures, the different moneyness affects informed traders' choice to realize their private information. Therefore, it is expected that the moneyness of considering the volume effects of options trading should provide more information content.

3.1.4. The ratio of options to stock trading volumes

Previous study as Chen, Lung, and Tay [11] and Roll, Schwartz, and Subrahmanyam [22] indicate that the ratio of options trade volume to stock market trading volume relate to many intuitive determinants such as delta and trading cost, and it also varies with institutional holding. They consistently argue that the ratio can depict that investors are attempting to exploit what they believe is privileged information. In addition, they show that the ratio depends on the available degree of leverage in options and institutional holding. Given the relevant, this study mainly focuses on the effects of trading activities of different investor classes on stock market. By above, we adopt the ratio of options to stock trading volume (O/S) to investigate the reciprocal effects between options market and stock market when options trade volume change. It is expressed as

$$O/S_t = \frac{\sum_{k=1}^{N}\sum_{j=1}^{15} \textit{Option Trading Volume}_{k,j}}{\sum_{j=1}^{15} \textit{Stock Trading Volume}_{j}} \tag{3.5}$$

where the O/S_t presents the ratio of options to stock trading volumes at interval t. The $\textit{Option Trading Volume}_{k,j}$ is the call or put options trading volumes of investor classes k at time j. The $\textit{Stock Trading Volume}_{j}$ is the total trading volumes of stock market at j minutes. In particular, because we stress the trading effects of some relevant investor classes, which have altogether N categories in this study, we only consider the effects of total options trading volumes of N investor classes on whole stock market trading volume to eliminate the influence of other irrelevant investor classes. Thus, the ratio may be more suitable for our objectives.

3.2. Methodology

In empirical model, the regression model is used to investigate the effects of total options volumes of the volume-weighted average moneyness on stock market returns and the O/S ratio. Specifically, to gauge the options time leveraged effects, the essay establishes the time-series regression model by different term-to-expiration. In addition, considering trading frequencies and trading volumes, the study only selects the options contracts of short-term month and the next two calendar months and run the following

regression using call or put options observations. The two regressions are expressed as follows.

$$R_t = \beta_0 + \beta_1 SVolume_t + \beta_2 NVolume_t + \beta_3 FVolume + \varepsilon_t \tag{3.6}$$

$$O/S_t = \beta_0 + \beta_1 SVolume_t + \beta_2 NVolume_t + \beta_3 FVolume_t + \varepsilon_t \tag{3.7}$$

In Equation (3.6) and (3.7), the R_t and O/S_t present the stock market returns and the ratio of options to stock trading volumes at interval t, respectively. The $SVolume_{s,t}$ stands for the total options trading volumes of short-term month contracts under 30 days, The $NVolume_t$ is the total trading volumes of all options contracts during the 30-59 expiration days. The $FVolume_t$ is the total trading volumes of all options contracts during the 60-90 expiration days. Finally, the error term (ε_t) is a random variable.

Recent studies as Cao and Wei [4] find that the problem of asymmetric information in options market is greater than stock market. In addition, Easley, OHara, and Srinivas [14], Pan and Poteshman [20] and Chang, Hsieh, and Lai [9] also show that options trading volumes contain information about future stock prices. In other words, this implies that informed trader will tend to use the leveraged effects of options market to capitalize their superior information when information transmission is inefficient. The problems may increase the ability of manipulated price of informed investors, and furthermore, resulting in wrong investment decision of uninformed investors. Consequently, we can anticipate that the positive (negative) relationship between call (put) options trading volumes and stock market returns, as well as there is a positive (negative) effects on O/S ratio. On the other hands, because of the problems of liquidity, bid-ask quoted price, and trading frequency, the relationships among variables may be contingent in the next two contracts months. If the time leveraged effects exist in the options market, the opposite direction can be expected. Therefore, when the investors hold similar perspectives universally, the identical relationship will happen between two markets. To solve the problems, we will provide empirical results and detail analysis.

4. Empirical Analysis and Results

4.1. Data sources

This study mainly focuses on the effects of options trades of on stock market returns and to investigate whether the influences of options trades are significantly different among different investor types. On a global scale, the market capitalization growth of the TWSE was ranked the eleventh in the world in 2009. Furthermore, the trading volumes of index options contracts from the Taiwan Futures Exchange (TAIFEX) are ranked fifth.[1] Because this study aims to observe where the informed traders trade during global financial crisis, the period can obviously know whether there is discrepancy among different traders. Specially, this study takes advantage of unique options transaction

[1]The historical statistics are obtained from the 2009 market highlights of the World Federation of Exchanges website.

data. It was obtained from Taiwan Futures Exchange (TAIFEX), the database includes more detailed transaction records of all index options contracts and the original tick-by-tick options data can present more trading tendency than daily data. The Taiwan stock index options (TXO) is used to do our objectives. The TXO holds maximum options market capitalization and liquidity in the Taiwan option market, and the underlying asset is the Taiwan Stock Exchange Capitalization Weighted Stock Index.

In addition, the data source for the stock market returns is the Taiwan Economic Journal (TEJ) database. The intraday data span a period that starts on Jan. 2, 2008 and ends on June 30, 2009. The unique dataset provides the tick-by-tick option transaction data, including the different investor classes, trading volumes, trading time, strike price, expiration date, and bid and ask quote prices. The transaction data can be completely identified for different investor classes. The study identifies 36 categories of dealers, securities investment trusts, bank investors, foreign institutional investors, market makers, and individual investors. The data used here are similar to data used by Chang, Hsieh, and Lai [10], who investigated the predictive power of the put and call positions with respect to different traders, but the current report provides more precise and timely information. For example, the TAIFEX established the hedging account of institutional investors on Oct. 13, 2008, which is different from the general account.[2] This allows us to identify which option trades of institutional investors represent leverage preferences or hedging demand. In addition, the regulators hope to reduce the effects of arbitrage and manipulation. A new settlement mechanism has been in place since Nov. 27, 2008, and it may change the trading behaviors of options market investors.[3] Consequently, the features of our dataset contain more detailed information on the different legal systems.

This TXO is European-style options and the underlying asset is the Taiwan Stock Exchange Capitalization Weighted Stock Index.[4] Similarly to Cheung et al. [13], Lee and Chen [18] and Chan, Chang, and Lung [8], this study uses fifteen-minute trading intervals to observe the TXO call and put option trading activities. We also observed the return variations of the Taiwan Stock Exchange Capitalization Weighted Stock Index. In addition, the trading times differ slightly between the two markets, the option trade time runs from 8:45 AM to 1:45 PM locally, but the stock market opens at 9:00 AM local time and closes at 1:30 PM. To overcome the problem of the different trading times and to minimize measurement errors, we combined the TXO option data with index return data and used the transaction data between 9:00 AM 1:30 PM. Finally, considering the liquidity and the size of trading volumes, this study only considers the contracts with

[2]Since Oct. 13, 2008, the regulators have loosened the options position limitation of institutional investors depending on the market value of the spot positions to satisfy the hedging demand of institutional investors. However, the hedge account is restricted so that the net positions of institutional traders in futures and options do not exceed the holding market value of the spot market.

[3]For this study, the sample period is from January 2008 to June 2009. In the past, the TAIFEX settlement mechanisms adopted the opening price over the interval from June 1999 to October 2001, the first fifteen-minute volume-weighted average of each component stocks prices from November 2001 to November 2008, and the final thirty-minute average price on settlement day from December 2008 to the present.

[4]The last trading day and delivery months are the third Wednesday of the delivery month of each contract and the spot month, the next two calendar months, and the next two quarterly months, respectively.

a term-to-expiration shorter than 90 days. If there is the missing problem of trading records, this study will delete the trading data.

In contrast with measures used in prior studies, this measure can effectively know where the investors tended to trade. It depends on the option strike price. We calculated the *VWM*. According to the method used by Chen, Lung, and Tay [11] and Chan, Chang, and Lung [8], to avoid potential bias caused by deep in-the-money and deep out-of-the-money options, this study calculates the volume-weighted average moneyness and the O/S ratio between 0.8 and 1.2. We define the different ranges of moneyness: out-of-money (*VOTM*), at-the-money (*VATM*), and in-the-money (*VITM*). The ranges of call/put options are defined as follows: *VOTM* options represent a ratio between 1.01/0.8 and 1.2/0.99, *VATM* options represent a ratio between 0.99 and 1.01, and *VITM* options represent a ratio between 0.8/1.01 and 0.99/1.2.

4.2. Descriptive statistics

The trading volumes of different options contracts based on moneyness are important variables. In this section, the time leveraged effects of various term-to-expiration contracts are observed first. These factors may provide us some important information because the problems of liquidity impediment and quote price inefficiency affect the trading desirability of market investors. Therefore, following Chang, Hsieh, and Lai [9], we classified the short-term contracts (under 30 days), medium-term contracts (30-59 days), and long-term contracts (60-90 days) based on the listing of the series of expiration months in TAIFEX. To ensure that we would have enough observations to examine the trading volume effects among the different investor classes, we also exclude the contracts whose expiration lengths were larger than 90 days, namely the next two quarterly months contracts. On the other hands, this study only focuses on the five main investor categories such as dealers, investment trusts, foreign institutional investors, market makers, and individual investors. The total options trade volumes, therefore, are only calculated for these classes. This insulates the potential errors in measurement from other investor classes.

Table 1 and Table 2 summarize the stock market returns, the ratio of options to stock trading volumes, and the fifteen-minute volume-weighted average moneyness. Preliminary results suggest that the mean value and standard deviations of fifteen-minute stock market returns are -0.0033% $\pm$ 0.1408 for 4,586 observations and -0.0044% $\pm$ 0.1393 for 4,473 observations. The outlier distances account for approximately 2.0658%. In addition, the mean and standard deviation of the O/S ratio of three different term-to-expiration contracts are (0.0813% $\pm$ 0.0819, 0.0055% $\pm$ 0.0778, 0.0003% $\pm$ 0.0262) for call options and (0.0584% $\pm$ 0.0759, 0.0038% $\pm$ 0.0738, 0.0002% $\pm$ 0.0133) for put options. With respect to the moneyness, the statistics indicates that the volume-weighted average moneyness, considering the factors of investment sentiment and trading tendency, usually lies in out-of-the-money category. The mean value of call options was between 1.0395 and 1.1215 and between 0.8960 and 0.9483 for put options. In addition, the volatility of 60- to 90-day contracts leads to more fluctuation. This reflects the observation that the mid- and long-term option contracts hold more time value. These

results clearly indicate that the average intraday returns and relative trading volumes ratios are more volatile, particularly in the short-term contracts (under 30 days). The total options trade volumes of the five investor classes have an approximate stock market trading volumes as well as trade in VOTM contracts. Thus, this clearly state that there is a significant influence of the leveraged preference for investors and trading purpose in the options and stock markets. Moreover, the average trading volumes for the stock market are contemporaneous when the option market activities increase, but the reciprocal effects between the two markets were gradually reduced along with increases in the lengths of the time-to-expiration. The observed results are also consistent with the pooling equilibrium hypothesis (Chen, Lung, and Tay [11]).

To capture the trading tendency of market investors, we identify three different moneyness indicators to describe the real effect. The volatilities of different moneyness are of particular interest: We find that the $VOTM$ in call options fluctuated more for contracts with different terms to expiration, and this accounts for its presence approximately the trading proportions between 75% and 96% for all observations. In addition, there are similar results among the put options. Although the $VOTM$ in all put options contracts do not present the largest volatility, it still reaches 0.0276 in the short-term contracts and was approximately 84% to 97% for all observations. Therefore, the out-of-the-money options play the most significant role, in addition to information content in Taiwan. In particular, they may attract the trading activity of informed traders as foreign institutional investors seeking to obtain the highest leveraged effects (Chang, Hsieh, and Lai [9]). The results are also consistent with prior studies by Chakravarty, Gulen, and Mayhew [5] and Chen, Lung, and Tay [11]. Therefore, we infer that out-of-the-money options contracts are more informative, and the more detailed analysis is reported in Table 3 and Table 4. Except for under 30 day contracts, all of the moneyness classes in 30 to 59 days and in 60 to 90 days. The call option contracts exhibit the characteristics of right skewness and kurtosis, and all of the put option contracts display the left skewness and platykurtic. Finally, Figure 1 and Figure 2 depict the behavior of call and put option moneyness, respectively, in the short-term contracts.

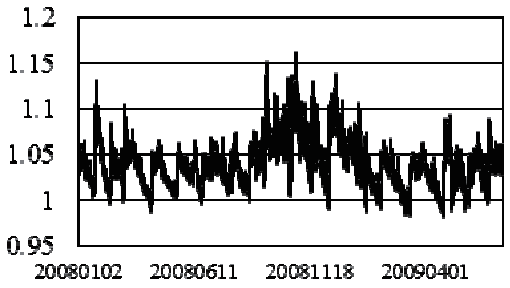

Figure 1: call options moneyness in short-term contracts.

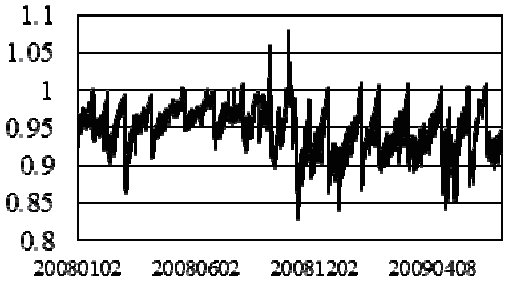

Figure 2: put options moneyness in short-term contracts.

To gain an understanding of the trading behaviors of different investor classes, we identified five classes: dealers, investment trusts, foreign institutional investors, market

makers, and individual investors. After controlling for the varying moneyness effects and investor types, Table 3 and Table 4 report the descriptive statistics of the relative trading volume ratio in all investor classes. Table 3 indicates that average trading volumes of the *VOTM* contracts of investment trust investors, foreign institutional investors, and individual investors under 30 days were frequently larger than those of the other moneyness categories. Although the *VITM* are larger than the *VOTM*, the trading frequency is very low, which also suggests that these investors still prefer leveraged effects over other moneyness factors, and the information share tended to be higher for out-of-the-money options (Chakravarty, Gulen, and Mayhew [5]). However, the dealers trade in *VATM* spaces, which indicates that they may be more sensitive to asset price volatilities and prefer low bid-ask spreads (Kaul, Nimalendran, and Zhang [16]). Comparing the difference between foreign institutions and individuals, the foreign institutions prefer to trade in *VATM* in the mid- and long-term option contracts. This indicates that the foreign investors tend to pursue more liquid and more sensitive to volatility. However, the individuals present mixed preference. In addition, for near contracts and second near contracts of put options the foreign investors tend to buy the contracts of *VITM*, pursuing more sensitivity of underlying asset price changes, but the individuals tend to trade more leveraged effects. In fact, we do not have sufficient evidence to explain the options that the market makers chose to trade because they are required to perform some obligations as minimum monthly trading volumes.[5] Therefore, according to the preliminary results, the trading preferences and trading tendencies among different investor classes have a significant disparity. Additionally, the trading tendency also presents obvious differences among the three expiration time classes. In particular, the foreign institutional investors prefer to trade *VATM* in 30 to 59 days and 60 to 90 days contracts, but the other classes are quite mixed. This may imply that a problem of asymmetric information exists in the Taiwan options market.

Similarly, these results are also found in put option contracts. All of the investor classes chose to trade the *VOTM* options in the short-term contracts (under 30 days) except for the market makers. This indicates that the out-of-the-money options play an important role in determining price regardless of the call or put option contracts. Therefore, the *VOTM* options provide more information content than other moneyness classes. Additionally, the average fifteen minutes trading volumes of investment trust investors in 60 to 90 days contracts are quite low in call options and do not represent any trading activity among the put options. Perhaps intuitively, the time leveraged effects do not attract this category of investors. In other investor classes, the trading tendency was mixed.

[5]In Taiwan, futures dealers or specified institutional investors may apply to become a TAIFEX market maker and engage in a market-making business after obtaining approval from the TAIFEX. They can obtain some reward or a reward of a commission fee deduction. However, they must perform some obligations, such as maintaining a minimum monthly trading volume, bid-ask quotations, and less liquid options.

4.3. Regression results

To further investigate the influence of time leveraged effects across various term-to-expiration contract lengths, we perform a regression of Equation (3.6) and Equation (3.7) for the call and put options. Table 5 shows that the effects of short-term contract trading volumes are relatively greater than the effects of contracts of other lengths. Firstly, in the contracts that are under 30 days, the estimated coefficients of options trading volumes on stock market returns are negatively insignificant for call options and slightly significant at the 10indicate that an option trades may contain some information about stock price movement, although it does not provide strongly significant results.

In addition, an interesting findings based on our estimation are that the options trades of other contracts do not relate to the stock market returns. None of the options trading volumes affected the stock market returns in 30 to 59 days contracts or 60 to 90 days contracts. Therefore, the regression results reveal strong evidence that market investors are more sensitive to the liquidity effects than to the time leveraged effects. More generally, another possible explanation is that some agents trade only in stock and others use options for hedging. For example, when the trading volumes of options increases, these agents are suggested to hold call options (put options) to hedge short (long) positions or to perform reverse covered call (protective put). Therefore, the benefits of time leverage may not attract them. Thus, these noise traders may cause only insignificant effects. In our analysis of O/S ratio, we find similar results, i.e., the coefficients for the options trades in short-term contracts are positively significant in the entire sample but negatively significant in other contracts. If options are more informative, the increases in options trading volumes are larger than increases in stock market trading volume (Chakravarty, Gulen, and Mayhew [5]). This implies that a negative result is less informative. Therefore, the results show that the short-horizon options trades contain more information. Additionally, because the market is not sensitive to the length of time to expiration, as was previously stated, investors such as noise traders and informed traders will tend to reduce the mid- or long-horizon contracts. Thus, the opposite relationship can be expected for 30 to 59 days and 60 to 90 days contracts.

5. Conclusions

What is the information content of informed trade in the options market? This question continues to attract the interest of numerous researchers and practitioners who investigate the realized information behind the options trade. However, the information on this topic in the literature remains ambiguous. To shed some light on this issue for the options market, this study attempts to explore more information content than other have previously analyzed and provide a complete analysis of informed trade. In this study, the unique dataset from the TAIFEX options market provided us with original transaction records for all investor classes in the Taiwan options market. We sought to determine the realized trading tendency of informed traders, where informed traders choose to trade. Considering the stock returns response and the reciprocal effects between options and stock markets, our findings provide some important information.

Table 1. Summary statistics for different volume-weighted average moneyness and different term-to-expiration of call options.

	Mean	Sigma	Skewness	Excess Kurtosis	Maximum	Minimum	No. of observation
Stock Market Returns (%)	-0.0033	0.1408	-0.0977***	3.7030***	1.0591	-1.0067	4586
Short term contracts: under 30 days							
O/S ratio (%)	0.0813	0.0819	-2.3960***	8.6460***	0.7828	0.0003	4586
VWM	1.0395	0.0256	0.7235***	0.9359***	1.1608	0.9809	4586
VOTM	1.0488	0.0215	1.3092***	2.0215***	1.1608	1.0200	3518
VATM	1.0092	0.0078	-0.5332***	-0.8132***	1.0199	0.9903	1044
VITM	0.9874	0.0023	-1.4034***	1.5615	0.9898	0.9809	24
Medium-term options: 30-59 days							
O/S ratio (%)	0.0055	0.0778	2.1720***	6.1192***	0.6643	0.0002	4788
VWM	1.0824	0.0398	1.2244***	4.1056***	1.3714	0.9393	4788
VOTM	1.0821	0.0336	0.7055***	0.2977***	1.1998	1.0200	4612
VATM	1.0105	0.0071	-0.6465***	-0.7000	1.0195	0.9924	100
VITM	0.9717	0.0192	-0.7193	-1.2260	0.9898	0.9393	13
Long-term options: 60-90 days							
O/S ratio (%)	0.0003	0.0262	20.5729***	515.2156***	0.7828	0.00003	4788
VWM	1.1215	0.0988	1.4700***	5.3548***	1.7996	0.6792	4788
VOTM	1.1029	0.0458	0.2629***	-0.8349***	1.1999	1.0200	3579
VATM	1.0052	0.0084	-0.0384	-1.1856***	1.0196	0.9900	260
VITM	0.9473	0.0399	-1.0535***	0.2277	0.9898	0.8176	178

Note: The table reports the descriptive statistics of different call option leverage at the interval fifteen minutes in Taiwan option market over the January 2, 2008 to June 30, 2009. The *VWM* stands for the volume-weighted average moneyness as exercise price divide by stock price. The O/S ratio is the ratio of option trade volume to stock market trading volume. In the essay, we define the different moneyness ranges based on the below criterions. We cut off less than 0.8 or greater than 1.2 of ratio of volume-weighted average strike price to Taiwan stock index. The ranges of call options are defined as: out-of-money (*VOTM*) options are the ratio of between 1.02 and 1.2; at-the-money (VATM) options are the ratio between 0.99 and 1.02; in-the-money (VITM) options are the ratio between 0.8 and 0.99. The asterisk *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2. Summary statistics for different volume-weighted average moneyness and different term-to-expiration of put options.

	Mean	Sigma	Skewness	Excess Kurtosis	Maximum	Minimum	No. of observation
Stock Market Returns (%)	-0.0044	0.1393	-0.1106***	3.6848***	1.0591	-1.0067	4473
Short term contracts: under 30 days							
O/S ratio (%)	0.0584	0.0759	-2.4879***	9.8033***	0.9997	0.1568	4473
VWM	0.9483	0.0303	-0.2866***	0.0114	1.0790	0.8277	4473
VOTM	0.9443	0.0276	-0.5718***	-0.1296*	0.9899	0.8277	4151
VATM	0.9967	0.0047	1.1838***	2.3402***	1.0191	0.9900	301
VITM	1.0400	0.0123	1.8046***	4.0125***	1.0790	1.0240	21
Medium-term options: 30-59 days							
O/S ratio (%)	0.0038	0.0738	2.5975***	10.7201***	0.0002	0.8416	4663
VWM	0.9033	0.0449	1.6041***	18.5492***	1.5951	0.7403	4663
VOTM	0.9015	0.0367	-0.1350***	-0.4405***	0.9894	0.8002	4521
VATM	1.0007	0.0076	0.7319**	-0.3507	1.0194	0.9903	64
VITM	1.0729	0.0481	0.6967	-0.9795	1.1703	1.0215	28
Long-term options: 60-90 days							
O/S ratio (%)	0.0002	0.0133	7.1685***	70.6645***	0.2248	0.00004	4663
VWM	0.8960	0.0864	2.3142***	18.7667***	2.0935	0.5907	4663
VOTM	0.8918	0.0446	0.0184	-0.6487***	0.9898	0.8001	3905
VATM	1.0022	0.0084	0.4901**	-0.9081**	1.0198	0.9902	157
VITM	1.0882	0.0560	0.6284***	-0.9160**	1.1986	1.0201	155

Note: The table reports the descriptive statistics of different put option leverage at the interval fifteen minutes in Taiwan option market over the Jan. 2, 2008 to June 30, 2009. The *VWM* stands for the volume-weighted average moneyness as exercise price divide by stock price. The O/S ratio is the ratio of option trade volume to stock market trading volume. In this study, we define the different moneyness ranges based on the below criterions. We cut off less than 0.8 or greater than 1.2 of ratio of volume-weighted average strike price to Taiwan stock index. The ranges of put options are defined as: out-of-money (*VOTM*) options are the ratio of between 0.8 and 0.99; at-the-money (*VATM*) options are the ratio between 0.99 and 1.01; in-the-money (*VITM*) options are the ratio between 1.01 and 1.2. The asterisk *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 3. Average fifteen minutes trading volumes sorted by different investor classes and different volume-weighted average moneyness for call options.

	Dealers	Mutual funds investors	Foreign institutional investors	Market makers	Individual investors	No. of Observations
Short term contracts: under 30 days						
VWM	0.0211	0.0002	0.0430	0.5655	0.3702	4586
VOTM	0.0207	0.0002	0.0432	0.5649	0.3711	3518
VATM	0.0221	0.0001	0.0421	0.5699	0.3658	1044
VITM	0.0347	0.0006	0.0646	0.4746	0.4255	24
Medium-term options: 30-59 days						
VWM	0.0153	0.0017	0.1638	0.4128	0.4064	4788
VOTM	0.0151	0.0016	0.1621	0.4140	0.4072	4612
VATM	0.0254	0.0020	0.2145	0.4044	0.3537	100
VITM	0.0320	0.0010	0.2067	0.3468	0.4135	13
Long-term options: 60-90 days						
VWM	0.0040	0.0006	0.2295	0.2599	0.5061	4788
VOTM	0.0040	0.0007	0.2338	0.2637	0.4978	3579
VATM	0.0011	0.0000	0.2883	0.2519	0.4587	260
VITM	0.0055	0.0000	0.2371	0.2759	0.4816	178

Note: The table reports the call option average trading volume of various investor types at the interval fifteen minutes in Taiwan option market over the Jan. 2, 2008 to June 30, 2009. The *VWM* stands for the volume-weighted average moneyness as exercise price divide by stock price. In this study, we define the different moneyness ranges based on the below criterions. We cut off less than 0.8 or greater than 1.2 of ratio of volume-weighted average strike price to Taiwan stock index. The ranges of call options are defined as: out-of-money (*VOTM*) options are the ratio of between 0.8 and 0.99; at-the-money (*VATM*) options are the ratio between 0.99 and 1.01; in-the-money (*VITM*) options are the ratio between 1.01 and 1.2. The trading volume percentage of different investor classes at each trading types is the ratio of trading volume of different investor classes to total trading volume of different term-to-expiration.

Table 4. Average 15 minutes trading volumes sorted by different investor classes and different volume-weighted average moneyness for put options.

	Dealers	Mutual funds investors	Foreign institutional investors	Market makers	Individual investors	No. of Observations
Short term contracts: under 30 days						
VWM	0.0183	0.0001	0.0500	0.5553	0.3763	4473
VOTM	0.0184	0.0001	0.0510	0.5523	0.3782	4151
VATM	0.0173	0.0000	0.0366	0.5946	0.3515	301
VITM	0.0251	0.0013	0.0403	0.5932	0.3401	21
Medium-term options: 30-59 days						
VWM	0.0142	0.0008	0.1761	0.3986	0.4103	4663
VOTM	0.0142	0.0007	0.1769	0.3978	0.4105	4521
VATM	0.0074	0.0000	0.1298	0.4661	0.3967	64
VITM	0.0027	0.0000	0.2279	0.3838	0.3856	28
Long-term options: 60-90 days						
VWM	0.0028	0.0000	0.2278	0.2888	0.4806	4663
VOTM	0.0024	0.0000	0.2365	0.2834	0.4777	3905
VATM	0.0003	0.0000	0.2414	0.2690	0.4894	157
VITM	0.0048	0.0000	0.1888	0.2913	0.5150	155

The table reports the put option average trading volume of various investor types at the interval fifteen minutes in Taiwan option market over the Jan. 2, 2008 to June 30, 2009. The *VWM* stands for the volume-weighted average moneyness as exercise price divide by stock price. In this study, we define the different moneyness ranges based on the below criterions. We cut off less than 0.8 or greater than 1.2 of ratio of the volume-weighted average strike price to Taiwan stock index. The ranges of put options are defined as: out-of-money ($VOTM$) options are the ratio of between 0.8 and 0.99; at-the-money ($VATM$) options are the ratio between 0.99 and 1.01; in-the-money ($VITM$) options are the ratio between 1.01 and 1.2. The trading volume percentage of different investor classes at each trading types is the ratio of trading volume of different investor classes to total trading volume of different term-to-expiration.

Table 5: Regression results of stock market returns and O/S ratio on option market volumes, by term-to-expiration.

	Intercept	under 30 days	30∼59 days	60∼90 days	R^2 (%)
		Coefficient (White Std.)	Coefficient (White Std.)	Coefficient (White Std.)	
Call option: stock market returns (R_t)					
Entire sample	0.0124 (0.0103)	-0.0010 (0.0011)	-0.0003 (0.0003)	-0.0002 (0.0003)	0.0873
Call option: O/S ratio					
Entire sample	-0.8686*** (0.0378)	0.0999*** (0.0042)	-0.0017* (0.0009)	-0.0027** (0.0011)	24.2385
Put option: stock market returns (R_t)					
Entire sample	0.0188* (0.0101)	-0.0019* (0.0011)	0.0001 (0.0004)	-0.0002 (0.0004)	0.1344
Put option: O/S ratio					
Entire sample	-0.5778*** (0.0254)	0.0689*** (0.0028)	-0.0011 (0.0007)	-0.0021*** (0.0007)	21.3973

Note: The table reports the two regression models results of trading volume of call option and put option on stock market returns and O/S ratio at interval fifteen minutes in Taiwan option market. The O/S ratio is the ratio of option trade volume to stock market trading volume. The asterisk *, ** and *** denote significance at the 10%, 5% and 1% levels.

After controlling for the volume effects and different exercise prices, empirical results show that market investors prefer to trade the short-horizon contracts with larger trading liquidity and tend to choose the out-of-the-money options with higher leverage. In addition, there is a significantly positive reciprocal relationship between options and stock markets when the options trade increases. This is also consistent with the pooling equilibrium hypothesis. Therefore, we conclude the options trading patterns of dealers and foreign institutional investors in Taiwan provide more information regarding stock price movement.

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Department of Financial Management, College of Economics and Management, Hefei Normal University, Hefei 230061, Anhui Province, China.

E-mail: 38704895@qq.com

Major area(s): Corporate finance, financial market and regional economics.

Department of Banking and Finance, Tamkang University, New Taipei City 25137, Taiwan (R.O.C.).

E-mail: snapshop68@yahoo.com.tw

Major area(s): Market microstructure, financial econometrics and real estate finance.

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