Centre for International Capital Markets

Discussion Papers ***ISSN 1749-3412***

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No 2007-10

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July 2007

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Abstract

We examine the Taiwanese market for covered warrants, and the impact of the expiration of a covered warrant on the returns, and trading volume of the underlying stock. This paper seeks to address the impact of warrant expiration on the underlying shares. It proposes several sample groups in which such impact may emerge different outcome. Overall, the hypotheses of there are significant price effect and abnormal trading volume around the warrant expirations cannot be rejected. The hypotheses of different price effect and trading volume in sub groups also have been confirmed. This study makes extensive of data from Taiwanese market and several sample groups; the empirical analysis can also serve as a means to improve academic knowledge of impact derivative expiration event on the underlying shares. We conclude that the feature of the sample set does generate different results and we also provider alternative explanations to the empirical outcome.

JEL classification: G13; G14; G15; N2

Keywords: Covered Warrants, Synthetic Financial Derivatives, Stock Market in Taiwan

1. Introduction

Previous research in the covered warrants literature has neglected to consider the issue of warrant expiration. One of the plausible explanations may be the short of investigation period and lack of sample. The evolvement of Taiwan covered warrants was in 1997; therefore it is a relatively new financial derivative to the capital market. As a result, studies in Taiwan covered warrant market not just short but also contain a small sample sets. We are motivated in part by the fact of lack of academic research on the issue of derivative expiration. This paper contributes to the literature regarding another kind of financial derivative, with a central focus on the event of covered warrants expiration. We hope to address the gap in the covered warrants literature with a focus on the Taiwanese market.

The investigation of the price effect around options expiration requires us to look at the significance of abnormal return (Klemekosky (1978), Klemkosky and Maness (1980), Officer and Trennepohl (1981)). There is also a possibility that the issuer and investor create a down-turn price pressure through closing their position in the spot market as the options come to expiration (Klemekosky (1978) and Pope and Yadav (1992)). To summarize the above views, a significant price effect is likely to generate within the pre-expiration event window. However, if the evidence supports the semi-strong market efficiency theory, then there is no significant price effect to the option expiration (Bollen and Whaley (1999), Stoll and Whaley (1987, 1991)). Another interesting question is whether the option expiration contains any new information about the company and has the same reaction from the underlying share similar to the option introduction (Ross (1977)). The introduction of the option could affect the underlying asset because it might accelerate information efficiency; however, when option expiration is expected and it does not have the role of revealing company information, we might generate an insignificant price effect in underlying asset. For studies highlighting on the covered warrants market, Draper et al. (2001) and Chen and Wu (2001) obtain a negative

price effect after warrant delisting, however, Chen and Wu (2001) also generate a positive price effect prior to the warrants expiration. Hsu and Wang (2003) select 9 covered single call covered warrants between 2000 and 2001 from Taiwan covered warrants market. They apply the market model to examine the abnormal price effect of the underlying share around warrant introduction, listing and expiration days. Their empirical result confirms there is no significant change in abnormal returns and cumulative abnormal returns when warrants expired.

Te abnormal price effect could be caused by the abnormal trading behaviour between the seller and buyer in the market. It is likely that abnormal trading volume associated with the price effect in the event of warrant expiration. With the time pass by it is also possible that both price effect and abnormal trading volume been absorbed after the market participants reacted to the news. A few numbers of studies have examined the change of underlying asset trading volume around derivatives expiration in the various capital markets (Bhattacharya (1987), Chamerlain et al. (1989), Stall and Whaley (1991), Pope and Yadav (1992), Karolyi (1996), Draper et al. (1997), Chen and Wu (2001)). The empirical evidence are inconclusive, some research emerge significant change in trading volume. The plausible explanation is that the issuer starts to dispose their position in the spot market just before the option expiries; therefore, they create a high abnormal trading volume in the underlying asset market. As soon as these abnormal transactions become normal again when option expires, the trading volume also goes back to normal.

The central notion of the efficient market hypothesis (Fama (1970)) has suggested that the invention and trading of the option should be a separate scenario and hence has no impact on the underlying share if the market if efficient. Ross (1976) suggests that the existence of the options market improves market efficiency. Rubinstein (1985) agrees that the launch of the options market increases the investment opportunity for both firms and individual investors

and also increases the efficiency of the securities markets. However, if the evidence supports the semi-strong market efficiency theory, there would be no significant price effect to the option expiration.

Nevertheless, the attempt to establish a link between option expiration is at present inconclusive. This is why the aim of the paper is to give a clearer idea about covered warrants expiration. The rest of the paper is organized as follows: section 2 covers previous literature and hypotheses; section 3 deals with sample selection and methodology, section 4 focuses on empirical results and section 5 is the conclusion.

2. Previous Literature and Hypotheses

2.1 Price Effect

For the price effect on the derivative expirations, researchers provide various explanations. Klemekosky (1978), Klemkosky and Maness (1980), Officer and Trennepohl (1981) all suggest that the arbitrage transactions may cause a temporary price effect around the expiration date. They suggest that there is no price effect on the expiration of options. Officer and Trennepohl (1981) claim that there should be abnormal returns due to the change of trading volume in underlying assets around the date when the options expire, but this could be offset by search cost, transaction cost and tax. Stoll and Whaley (1987, 1990) claim that arbitrage activity does not cause price distortions. Bhattacharya (1987) notes that when the options approach the expiration time, some options holders may try to manipulate the futures price in order to benefit from the options market. Bollen and Whaley (1999) provide two alternative explanations for the insignificant price effect; the first that it is due to the early unwinding of the contract; the second is the popularity of the arbitrage programme. The authors claim that this may be only a recent phenomenon and therefore does not influence the underlying stocks.

This paper is the first attempt to examine the price effect of first and subsequent warrants expirations to the best of our knowledge. The different feature between the first time and subsequent expiration is expected due to the empirical evidence from warrant introduction. Furthermore, Draper et al. (2001) report negative price effect for both in and out-of-the-money groups in Hong Kong. Chan and Wu. (2001) report that the in-the-money warrants show a positive price effect before the warrant expiration and negative price effect after the expiration. The out-of-the-money group obtains negative price effect around the warrant expiration. We also divide the sample groups into in-the-money and out-of-the-money group, hoping to find different attribute between the two sub sample groups. There are reasons to believe that option expiration could have impact on underlying stocks. Therefore we propose the following hypothesis:

H1: There is a price effect on underlying stocks around (before and after) covered warrants expirations

H2: The sub-sample of first time expired covered warrants exhibit a different price effect from the sub-sample of subsequently expired warrants

H3: The sub-sample of in-the-money expired covered warrants exhibit a different price effect from the sub-sample of out-of-the-money warrants

2.2 Change of Trading volume

In the US market, Stall and Whaley (1991) suggest that the trading volume increases before the option expiration but falls after it, which is inconsistent with the insignificant finding by Bhattacharya (1987). Chamerlain et al. (1989) confirm insignificant result by examining the Canada market. Karolyi (1996), Draper et al. (1997), and Chen and Wu (2001) emerge positive trading volume in the Japanese futures options market and Hong Kong derivative

warrant market respectively. Pope and Yadav (1992) confirm a positive trading volume prior to and negative trading volume post the option expiration in the U.K.

Draper et al. (2001) claim that in their test of trading volume there was no significant effect associated with the listing of warrants; underlying stocks experience increased volume to the news of warrants delisting. Chen and Wu (2001)'s result is different; they find that the trading volume drops significantly around the maturity date.

Pope and Yadav (1992) suggest that because of the time premium of the call option, it should be more profitable to sell the call option than to exercise it much before option expiration. Hence, one would expect the stock trading volume could be peaked just before the option expiration because of call option exercise.

Chan and Wu (2001) there is significant trading volume change in both in-the-money and out-of-the-money expiration groups. To the best of our knowledge, none of the studies have investigated the change in abnormal trading volume of underlying shares after covered warrants expiration in Taiwan. The change of underlying share price is likely to be associated with movement in the underlying share trading volume. This gives rise to the second hypothesis:

H4: The trading volume of underlying stocks changes around (before and after) covered warrants listings

H5: The extent of changes in trading volume of underlying stocks for first time covered warrants expiration is different from the extent of changes associated with the subsequent expiration

H6: The extent of changes in trading volume of underlying stocks for in-the-money covered warrants expirations is different from the extent of changes associated with the out-of-the-money expirations.

There are more reasons for us to set out the above hypotheses on the basis of the institutional aspects of observations. It is crucial to consider the overall influence of option expiration on the underlying asset, from the scientific perspective; there may be a comprehensive diagram for the process and its impact. The expiration of the option will first of all create a high trading volume because the arbitragers, investors and the issuer will no longer have need to arbitrage, to hedge or to hold the underlying asset. A very important feature of the covered warrants, unlike the options, as we mentioned earlier, is that the options are issued by the stock exchange or clearing house itself, whereas a third party issues the covered warrants, normally investment banks. This feature actually plays a vital role in the event of covered warrants expirations. First, the government has required the issuer to provide a certain amount of hedging in order to prevent both parties from default risk. Therefore as the expiration dates approach, the issuer has to prepare enough shares in case the warrant holders ask for exercise when the warrants are in the money. Secondly, if the covered warrant is likely to expire out-of-the-money, the issuer may start to close off his hedging position by selling the shares in the market. Thirdly, there is a chance, as a counter-example, if the covered warrant is likely to expire in-the-money, the issuers and also some investors may try to manipulate the underlying share price in order to sell their shares at a better price later on. Fourthly, there is also a possibility that the price and trading volume of the underlying shares will suddenly go up because the demand for the underlying shares will shift back to the spot markets due to the lack of another financial assets. From above, we see that there are reasons to believe that the event of the covered warrant expiration affects the underlying shares. On the basis of these reasons derived from the Taiwanese market specifically and also from the previous literature, we then develop the above hypotheses.

The Taiwanese government has also applied capital constraint requirements to shares which can qualify as underlying shares. A list of companies can be selected as the committee reveals

underlying shares every three months. Therefore multiple listing situations arise in the Taiwanese market in which one underlying share might have more than one covered warrant presented at the same time. For this crucial phenomenon, in the present paper we choose to observe abnormal trading activities during the short-term pre and post warrant expiration, rather than examining the change of systematic risk and long term stock volatility after covered warrant expiration. The reason for this is that we simply cannot claim the flotation of the systematic risk and long-term stock volatility change after the warrants expiration is due to expiration itself. As the warrants are no longer trading, the long term proxy should not contain any information regarding either the event or this particular asset. Moreover, there are numerous different events which may emerge for the underlying company after the warrants have expired and we cannot distinguish the impact of one particular event from another.

3. Data and Methodology

3.1 Sample Selection

Our sample consists of 138 covered warrants expirations, including 50 first expiration covered warrants. The sample is drawn from data between August 1998 and August 2003. The daily closing prices of the underlying stocks and covered warrants were chosen.[1] The expiration date is the day when the covered warrant matured, which normally would be a year after the listing of the covered warrant, but a few of them expired after 6 months.[2] The daily underlying stocks and market trading volumes, daily trading volume and turnover of each underlying share are collected from the Taiwanese Economics Journal (TEJ) database. We further split our sample into an in-the-money group and an out-of-the-money group. In total, 32 warrants expired in-the-money, and 106 warrants expired out-of-the-money. 10 out of 32

[1] Daily stock return is calculated $r_t=\ln (P_t/_P P_{t-1})$, where P is the daily closing price.

[2] Cs1, tone4, asus4, paoc3, weis2, scip4, huhi1, ts5, kmt1, huay1, thu1, kua2, and yulg1, 13 in total have a -month maturity period.

in-the-money warrants are first time expired and the remaining 22 samples belonged to the subsequent-expired sample set. To summarize, 5 sample sets are examined, including the total sample group (138 covered warrants), the first time expired group (50 covered warrants), the subsequent expired group (88 covered warrants), the in the money group (32) and the out of the money group (106) covered warrants.

3.2 Methodology

Price Effect

Daily stock returns are calculated 160 (60) days before and 10 days after the expiration of the covered warrant. An event study methodology is applied to examine the abnormal return and cumulative abnormal returns happening before and after the warrant expiration. The period 10 days before and 10 days after the warrants expiration are set as the event windows. We applied two estimation periods to ensure the robustness of our empirical examination. One is 150 days before the event window; the other is 50 days before the event window. 150 days represents a long-term estimation and 50 days represents a short-term measurement. If we select too long as the estimation period, the next warrant expiration with the same underlying shares might affect the estimation; therefore, 150 days and 50 days seem to be reasonable measurements.

Between each covered warrants event/expiration, we make sure there is a two months gap of multiple listing, to make our estimation period more accurate. The length of the event window has been subjective in all the previous literature. In the covered warrants study, Chen and Wu (2001) choose 15 days as their event window, whereas Pope and Yadav (1992) select 5 days as the event window. We choose 10 days before and after the expiration window. The reason for this length is as follows: 1). The expiration of covered warrants is considered as news releasing; therefore it is unlikely to have a permanent influence on the underlying shares; 2).

Fama et al. (1969) suggested that the event window can be selected before and after the event and that it can also be extended up to the event. In order to observe the information linkage (Ball and Brown (1968)), we choose 2 weeks trading days before and after the expirations in order to capture the impact of the event.

3.1 Abnormal Return

The market model is adopted to examine the abnormal return, Brenner (1977) discusses variants models in the event study and he claims that the market model performs as good as other variants. The underlying share prices are determined partially by the market returns, market model is a fit model for our case.

Under the market model, the expected rate of stock return is calculated by the following OLS (Ordinary Least Square) estimation during the estimation period. The expected stock return during the event window is:

$$E\{R_{it}| X_t\} = \alpha + \beta * R_{mt} \qquad E \in W \tag{1.4}$$

R_{it} is the return on individual underlying stock, R_{mt} is the return on market index.

After using the estimation period to estimate α_i and β_i, the abnormal return during the event window equals to:

$$ARit = Rit - (\hat{\alpha}i + \hat{\beta}i * Rmt) , \qquad t = 0,1,2,3.....T \tag{1.5}$$

R_{it} denoted the actual return of individual underlying stock during the event window and $(\hat{\alpha}i + \hat{\beta}i * Rmt)$ is the theoratical stock returns.

The aberage abnormal returns (Brown and Warner (1985)) during the event window equal to :

$$AR_E = \frac{1}{N}\sum_{i=1}^{N} AR_{iE} \quad E \in W = \left[t_3, t_4\right] \qquad (1.6)$$

Karafiath (1988) sets a dummy variable every day to consolidate both estimation period and event window data.

$$R_{it} = \alpha_i + \beta_i * R_{mt} + \sum_{j=0}^{T} rijDjt + \varepsilon_{it,} \qquad i= 1,\ldots.N, \quad t = -T_1,\ldots..,T. \qquad (1.7)$$

D_{jt} = { 1, if t = j }, { 0, otherwise }

3.2 Cumulative Abnormal Return

To test the cumulative abnormal return, the following formula is adopted (Fama et.al. (1969)):

$$CAR\ (T_1, T_2) = \sum_{E=T_1}^{T_2} AR_E \qquad [\ T_1,T_2] \subset [\ t_3,t_4] \qquad (2.1)$$

To overcome problems of cross-sectional dependence and event-induced variance change, The Sign test is applied to test the significance of abnormal return in the event window.

3.3 Change of Relative Trading Volume Before and After Warrants Expiration

To examine the change of trading volume 100 days before and after the warrant expiration, we define the relative trading volume as the average ratio of a firm daily trading volume divided by total daily trading volume of the market over estimation period and the event window. The relative trading volume is measured as:

$$RV_{i,B} = (V_{i,\, t-s} / TV_{m,\, t-s}) *100 \quad (3.1)$$

$$RV_{i,A} = (V_{i,\, t+s} / TV_{m,\, t+s}) *100 \quad (3.2)$$

where $RV_{i,B}$ is the average daily relative stock trading volume before the warrants expiration and $RV_{i,A}$ is the average daily relative trading volume of security after the warrants expiration. 172 average ratios will be obtained. The Mann-Whitney test is adopted to test for the inequality of trading volume before and after the expiration of covered warrants.

Abnormal Trading Volume During the Event Window

Here we present a method to examine daily abnormal returns during the event window, this method is first derived by Michaely et al. (1995). Chen and Wu (2001) have adopted the medal to examine abnormal trading volume in their study. Daily turnover ratio is used as a proxy of trading volume. We choose 150 days and 50 days prior to the event window as our estimation period to calculate the average turnover ratio. The abnormal trading volume is defined as AR and obtained from comparing the daily turnover ratio within the event window to the average turnover ratio.

First of all, the daily stock turnover for individual underlying share is calculated as:

To_{it} = Number of shares traded $_{it}$ / Number of shares outstanding $_{it}$

i = 1….N , number of underlying shares, in total, N=138

t = -160….-11 for 150 days estimation period, and –60….-11 for 50 days estimation period.

The average estimated daily turnover for each underlying share is

$$\overline{TO_i} = \sum_{t=-160}^{-11} TO_{it} / 150 \quad \text{for 150 days estimation period} \tag{3.3}$$

$$\text{and } \overline{TO_i} = \sum_{t=-60}^{-11} TO_{it} / 50 \quad \text{respectively.} \tag{3.4}$$

The cross sectional daily turnover for day t is average turnover for all underlying shares,

$$TO_t = \frac{1}{N} \sum_{i=1}^{N} \frac{TO_{it}}{\overline{TO_i}} \qquad \text{t = -160…-11 (-61 …-11 respectively,)} \tag{3.5}$$

N = number of shares = 138.

TO_{it} = daily turnover at day t for each share, $\overline{TO_t}$ is the average turnover for each share.

The abnormal trading volume is calculated

$AVit = TOt - 1$, TOt is the cross sectional daily turnover

t = -161….-11 , (-61….-11) respectively.

$$\text{S.D. } (AV_t) = \frac{1}{149} \sum_{-160}^{-11} (AV_t - \overline{AV})^2 \quad \overline{AV} = \frac{\sum_{t=-60}^{-11} AV_t}{50}, \tag{3.6}$$

$$\text{Or } \frac{1}{49} \sum_{-60}^{-11} (AV_t - \overline{AV})^2, \qquad \overline{AV} = \frac{\sum_{t=-60}^{-11} AV_t}{50} \qquad \text{for 50 days estimation period.}$$

By calculating the average cross sectional abnormal trading volume we are able to observe the interactions between underlying share price performance and trading volume within the event window, which seizes impact of covered warrants expiration on the underlying shares in more detail.

4. Empirical Results

4.1 Abnormal Returns and Cumulative Abnormal Returns

The price effect is examined by applying market model. We applied two estimation periods, one is 150 days and the other is 50 days, to improve the robustness of our empirical testing. Result of 150-day estimation is presented here and the 50-day estimation generates consistent result as 150 day- estimation. Results for the 50-day estimation are available on request. Given emphasis to the importance of the nature of the covered warrants, 5 sample sets are examined based on diffident attribute. The 5 groups include the total sample group, the first time expired group, the subsequent expired groups, the in-the-money group and the out-of-the-money group. The in-the-money group includes those expired with in-the-money market price and the out-of-the-money group includes those could not be exercised when warrants were expired. We are hoping to find a distinct feature of the group which obtains significant trading behaviour on the basis of different categories.

The results of the expiration of covered warrant show different features in the total sample set, the first expired warrant sample and the subsequent expired group. The total sample set finds insignificant change in the ARs around the warrant expirations. This result is consistent with Hsu and Wang (2003). However, for the first time expired group, when it comes to warrant expiration, significant price effects can be obtained within the event window on day –2,0,2 for the ARs. The subsequent sample set confirms significant ARs on day –4. [3]

Overall, both total sample and subsequent group show similar conclusions, that there are insignificant results in ARs around the warrants expirations. However, the first expiration group generates significant positive price effect. To the contrary, the total sample and subsequent sample set emerge none significant evidence.

[3]The 50-day estimation period for the total sample finds significant ARs on day 6 and 10, significant CARs on day –5. The first time expired group generates significant ARs on day –2,0,2 and CARs on days –8~-5, 2~10. The subsequent group shows none significant AR and CAR.

We further split our sample set by classifying the sample based on the in-the-money group and out-of-the-money group. The in-the-money group generates positive abnormal returns prior to the expiration date on day –1, and also negative abnormal returns on days +3, +4. The out-of–the-money group obtains the same result that there are positive abnormal returns on days –9, -8, +6, + 10.[4]

Results emerge from the total sample set and the subsequent sample set are consistent to the findings of Bhattacharya (1987), Chamerlain et al. (1989), Stall and Whaley (1991), and Karolyi (1996) that there is a little evidence of price effect. The insignificant finding in the total sample and subsequent sample group implies that overall the event of warrant expirations no longer conveys information related to the underlying company therefore it brings no impact on the underlying shares. This confirms the argument of Bollen and Whaley (1999). 88 out of 138 samples in the total group are subsequent expiration warrants, therefore it is not surprise that both group show a similar outcome. The result of abnormal price effect also consistent with Hsu and Wang (2003), they also confirm insignificant result. There is an alternative explanation for the insignificant result of total sample group and subsequent group, that after warrant expired, there is a high possibility that the investment banks continue renew the warrants buy placing a new issue of covered warrant of the underlying shares. The new issue of covered warrant with the same underlying shares implicit extends the duration of the warrants, therefore it generate no significant price effect. This phenomenon could due to the strict regulation on the capitalization and diversification of the underlying shares, the issuer end up with limited choices. On the other hand, investment banks implicitly extend the duration of covered warrants also provide the hedge tool for the underlying share holders and hence maintain the trading liquidity of both underlying shares and the covered warrants. To

[4] For the 50-day estimation period, results for in-the-money group show that –9, -3, -1, +3, +4 days within the event window have significant abnormal returns. However, 4 out of 5 show a negative coefficient. The out-of –money group confirms that there are positive price effects on days –9, -8, +6 and +10.

summarize, some issue of subsequent warrants can be seen as the extension of the original warrants therefore does not generate significant result, in addition, the subsequent warrants are the majority of the total sample group hence it also shows insignificant price effect.

In sum, underlying stocks seem to exhibit significant abnormal returns both before and after the event day for the first time expired group, in-the-money group and out-of-the-money group, providing evidence of the existence of price effect on the covered warrants expiration. The results of the in the-money expired group show that there is a positive abnormal return before the warrant expiration and a negative abnormal return after the warrant expiration. The finding of the negative price effect after delisting is consistent to the result of Draper et al. (2001) and Chen and Wu (2001). Once the covered warrant is matured, investors will no longer have derivative to hedge their position in the underlying securities, therefore, investors might sell the underlying stock. Furthermore, the issuer will have no need to hold the hedge amount of underlying stocks they will also unwind the share position and induce the negative price effect post warrant expiration.

4.2 Cumulative Abnormal Returns

The result of the expiration of covered warrant shows the same features in both total data set and the subsequent expired samples. Both sample sets find none significant CAR during the event window around the warrant expirations.[5] For the first time-expired group, when it comes to warrant expiration, there are significant positive price effects obtained within the event window, in particular, after the event days, on day –6 to day10.[6] Again, there is lack of significance on the CARs for the total sample and subsequent sample sets; nevertheless, the

[5] 50-Days estimation confirms there is positive CAR on day –5 for the total sample set and none for the subsequent group.

[6] The first time-listed group with 50 days estimation period also shows the consistency.

first time expired group shows strange evidence of significant positive CARs. Recognizing the ex facie nature of the sample set, the first time expired warrants has brought impact on the underlying shares. The market participants no longer have the choice of covered warrants to invest in the underlying company; the demand might shift back to the underlying share market and therefore cause positive price effect around the warrant expiration.

We further split our sample set by classifying the sample based on the in-the-money group and out-of –the money group. The in-the-money group generate negative cumulative abnormal returns on day -3. The out-of-the-money group with 150 days estimation period show that there is a positive cumulative abnormal returns on day –8, -7, -6,-5, -4 and + 10.[7]

The total sample set, subsequent sample set show insignificant CAR around the warrant expirations. The first time expired and the out-of –the-money groups confirm there are positive significant cumulative abnormal returns around the warrant expiration. The in-the-money group finds significant negative price effect on day -3. We find that the whole sample result is more close to the findings in the first time expired and out-of-the-money group that there are positive CARs around the warrant expirations. The coefficients of the ARs and CARs after the warrant expirations are mostly negative for in-the-money group and the subsequent expired group.

The strong positive price effect found in the first-time-expired group could due to the demand of the financial tool represents the underlying company shifts back to the spot market from the covered warrants market. The first introduction of the covered warrants can be seen as another asset for the market participants to invest in the underlying company, investors might be captivated by this new derivatives and the demand of the spot shares to the covered warrant

[7] For 50 days estimation periods, results for in-the -money group show that –3 day within the event window have significant negative abnormal returns. The out-of –money group confirms that there is positive price effects most of the days within the event window (Day –8, -7,-6,-5,-4,-3,-2,0,2,8,9,10)

with the same underlying company. When it comes to the expiration, the demand of covered warrants will no longer exist and all the possible investment in the underlying company shift back the share market and therefore create a positive price effect. It is also tangible that the out-of-the-money warrants could bring some perplexity to the investors over the fair value of the underlying shares. When the call covered warrants are out-of-the-money it could bring down turn pressure on the underlying shares. Therefore, it could be a good news to the underlying share when a deep out-of-the -money call covered warrant is going to expire; because it will no longer have disfavor impact on the underlying share. In the heat of this finding one must not lost sight of the component of the total sample set. 106 out of 138 total samples are out-of-the-money covered warrants, this could explain why the total sample group exhibits similar result to the out-of-the-money group. In addition, the expired of in-the-money warrants implies that the issuer and holders of covered warrants start to release their hedging position of underlying shares after the covered warrant expired hence produce a downward price pressure on the underlying shares. This finding is consistent with Pope and Yadav (1992) and Chan and Wu (2001).

4.3 Parametric and Non parametric tests for the equality of AR and CAR before and after warrant expiration.

Table 4 presents the T test and nonparametric tests (The Wilcoxon test) for the equality of abnormal returns and cumulative abnormal returns before and after the warrant expiration. Only the first time-listed group shows a significant difference between pre and post abnormal returns and cumulative abnormal returns. The abnormal returns do not reject the equity before and after warrant expiration for the total sample and subsequent groups. The subsequent group shows significant difference in CARs after the warrants expired. The coefficient of CARs in Table 2 also confirms that CARs become negative after warrant delisting for the

subsequent group, although they are not significant.

The results for average ARs during entire event window suggest positive average ARs for the total sample, as well the first time expired and out-of-the-money samples (Table 4 – Panel A). The results for average ARs during entire event window suggest negative average ARs for the subsequent expired and in-the-money samples Results for difference in average ARs, during the entire event window, suggest bigger average ARs for the first listings of sub-sample. (Table 4 –Panel B). Furthermore, bigger average ARs are generated for the out-of-the-money than the in-the-money group. The first sample and in-the-money sample show a downturn trend of stock return after warrant expiration. The Wilcoxon test confirms that abnormal returns are significant at 5 % level pre and post warrants expiration for only the first time expiration samples evidence of the impact of this event.

Panel B in Table 4 presents the equality test between ARs / CARs of the first time expired and subsequent expired groups. Panel C in Table 4 presents the equality test between ARs / CARs of in-the-money and out-of-the-money groups. The empirical results further suggest significant variations between the first time expired (in-the-money) and subsequent (out-of-the-money) groups. Overall, the empirical evidence shows prominent features of in-the-money and out-of-the-money sample set. In-the-money warrants brings negative impact on the underlying shares and out-of-the-money group brings positive impact post warrants expiration. Because out-of-the-money warrants dominates most of the sample component in total sample group (106, 77%) and the first-time-expired group (40, 80%), both sample sets show similar results to the out-of-the-money group.[8] One can conceive the issuer might no longer have any hedging position when the warrants are deep out-of-the-money. The

[8] For the 50-day estimation, the total sample, in-the-money and out-of-the-money group confirms equality before and after warrant expiration. The CARs for the first-time expired group and the subsequent expired group are not equal pre and post expirations. Results of inequality between the ARs / CARs of in-the-money and out-of-the-money groups suggest similar findings to the 150-day estimation period.

expiry of these warrants could be good news to the underlying share because it no longer have potential to distort the market value of the shares, especially when all these warrants are call warrants.

To sum up, the first time expired and subsequent sample sets generate significantly different results in price effect. The negative price effect in subsequent sample sets could due to the underlying share no longer have hedging tool and hence induce a distress on the underlying share price. The positive price effect in the first time expired confirms demand might shift back to the underlying share market. The in-the-money group generates similar result to Draper et al. (2001) and Chan and Wu (2001), that there is a negative price effect post warrant expiration. The down turn trend of the underlying share price may be induced by the warrant exercise and warrant issuer unwinding the hedging position. The out-of-the-money finds positive price effect prior to the warrant expiration, this implies that the deep out-of-the-money warrant may distress the interest of the market participants hence the expiration of these warrant becomes a good news to the underlying shares. The empirical evidence confirms the hypotheses for significant price effect around the underlying share expiration, and different feature between the first time/subsequent sample sets and in-the-money and out-of-the-money warrants.

4.4. Abnormal Trading Volume

4.4.1. Nonparametric Test

The result for the Wilcoxon Test of median RViB = RViA vs. median RViB not= median RViA provides the evidence that there is no difference between relative trading volume before and after warrant expiration. The total sample, first time expired, subsequent expired, in-the-money and out-of-the-money groups all find that there is no difference in relative trading volume before and after the warrant expiration. The comparison between the first time

expired group and the subsequent expired group confirms significant difference in the nonparametric Wilcoxon test but not the T test.

This result confirms the difference between cumulative abnormal trading volume 100 days pre and post warrants expiration. The empirical evidence confirms that in the long term, trading volume of the underlying share is not influenced by the event of warrant expiration. To investigate the behaviour of change of trading volume associate with change of the price for underlying shares around the warrant expiration, we choose daily turnover ratio of out proxy to further investigate abnormal trading volume within the event window.

4.4.2 Relative Abnormal Trading Volume

Table 6 presents relative abnormal trading volumes within the event window. Consistent with the abnormal price effect, we generate there are significant trading volume around the warrant expiration for the total sample, the first time expired, the subsequent and the out-of-the-money groups. Nerveless, the in-the-money group, find there is little evidence of significant change on underlying share trading volume around the warrant expiration. The insignificant trading volume for in-the-money group could due to lost of the attraction from the investors after warrants expired, it is also could because the reason that the warrant issuer and holders are selling their hedging position creating a downturn price pressure to distress the underlying share and this makes the underlying share becomes unpopular. The other plausible explanation could because after the warrants expired, there is no longer a hedging tool for the investors, the underlying shares therefore disfavour by the market participants. However, the result of abnormal trading volume for in-the-money group still associated with the price effect that there is a positive abnormal trading volume prior to the warrant expiration and negative trading volume post the expirations. Moreover, the exercise of the underlying share will not induce a dramatic change in the underlying share trading volume due to the hedging position

of the issuer. When the warrant holder comes along to exercise the warrant, instead of purchasing from the spot market, the issuer unwinding the pre-constructed hedging position to the warrant holder. The insignificant abnormal trading volume in in-the-money warrant groups can be explained by the reason that there is no unwinding behaviour from the issuer. Furthermore, if the issuer chooses to have cash settlement for the exercise of covered warrant, then there will be no selling behaviour from the warrant holder. Our empirical result in in-the-money group however is different from Chan and Wu (2001) in Hong Kong, the find a positive abnormal trading volume for in-the-money group.

4.4.3 Parametric and Non parametric tests for the equality of AR and CAR before and after warrant expiration.

Table 7 reports results of inequality test in average abnormal trading volume before and after warrant expirations for each sample group. All sample sets cannot reject the null hypothesis that abnormal trading volume are equalize before and after warrant expiration. This finding is consistent with what have been observed in change of the abnormal trading volumes during the event window. That there are positive abnormal trading volumes for the total, first time expired and out-of-the-money groups; and there is insignificant abnormal trading volume for in-the-money group and negative abnormal trading volume 1 day prior to the warrant expiration for the subsequent expired group.

Panel B and Panel C in the Table 7 report the equality tests of abnormal trading volume during the event window between the first/subsequent expired groups and the in/out-of-the –money groups. Empirical evidence confirms that there is significant difference between the abnormal trading volume between the first time expired group and the subsequent expired group. The in-the-money group and the out-of-the-money group also confirm the same results. There results are consistent with what have found in abnormal trading volume of

each sample group during the event window. There are positive abnormal trading volume around the warrant expirations for the first time expired warrants but there is negative abnormal trading volume 1 day prior to the expiration for the subsequent expired group. In-the-money group generate negative abnormal trading volume post warrants expiration whereas the out-of-the-money group find positive abnormal trading pre and post warrants expiration.

To summarize, empirical results in trading volumes for the total sample, first time expired and out-of-the-money groups are consistent with Stall and Whaley (1990), Draper et al. (2001), and Chen and Wu (2001) that there is significant abnormal trading volumes around the warrant expiration. The negative but insignificant abnormal trading volume for in-the-money group might explain the downward price effect make the underlying share become less popular. Investors might prefer to trade share, which has similar feature, but with a covered warrant yet not expired.

5 Conclusions

In this paper we investigate the impact of warrants expiration on the underlying shares. The primary objective is to investigate the trading behaviour of the underlying shares around the covered warrants expiration. Research has been in the vanguard of the study to examine the impact of options expiration on the underlying shares. This paper, to the best of our knowledge, is the first attempt to investigate abnormal trading volume around warrants expiration in Taiwan, and the second with a relatively large sample sets and subgroups in examining the price effect and abnormal trading volume around warrant expiration.[9]

Consistent with study for Chen and Wu (2001) in the Hong Kong market, we find there is significant positive price effect prior to and negative price effect after the expiration dates for

[9] Hsu and Wang (2003) examine abnormal price effect in Taiwan with 9 warrants.

in-the-money warrants. The in-the-money group and the subsequent group shows result which is consistent with Draper et al. (2001) and Chan and Wu (2001) that there is negative CAR after the warrant expiration. The results from first expiration and out-of-the money groups are more consistent that there are positive CARs and positive abnormal trading volumes around the warrant expirations.

Although results from in-the-money, out-of-the-money and the first-time-expired, and subsequent expired group are inconsistent. One shall not claim that these results are contradictive. There are some plausible reasons might explain the outcome in in-the-money group. First, when it comes to the warrants expiration, if the covered warrants are in-the-money, the warrants holders would go to the issuer to ask for warrant exercise. These warrant exercise actions do not affect the trading of the underlying shares simply because of the hedging position of the issuer already covers the demand and also sufficient to allow the exercise, when it approaches to the expirations, the issuer would have to deconstruct their hedging position so there will be negative price effect after the warrant expirations. Secondly, the issuer also possibly mark up the underlying share price in order to attract the other market participants and later on they can easily get rid of their hedging position, and this action might cause a temporary positive price effect.

The plausible explanation for the positive abnormal return in first time expiration group could due to the shift of investment tool demand from the warrant market to the underlying shares. The probable reason for the significant price effect on out-of-the-money sample could due to the new of warrants expiration is considered good news the underlying shares. The issuer and warrant holders may gradually unwind their position long time ago hence there is no downward pressure to the underlying shares. Furthermore, due to the strict market capitalization and diversification regulation in qualification of the underlying shares. The issuer may issue a new warrant with the same underlying shares or still hold the hedging

position as a reserve for next warrant issuance. Therefore, it is reasonable that there is no significant downturn price pressure on out-of-the money and the total sample group, since the majority of the covered warrants in our sample (76%) is expired out-of-the-money.

The first time expired covered warrants might have different features compares to the subsequent expired warrants. Investors may consider first time listed warrants as a substitution of the underlying share to invest in underlying company. After the warrants expired the investment in a particular underlying company will all shift back to the only financial tool, the underlying share. This brings a positive price effect and trading volume to the underlying shares. The subsequent expired warrants play the function more like a hedging tool. Once if those warrants expired, investors might shift away to the other warranted-shares and therefore cause a downward price pressure to the underlying shares.

This paper seeks to address the impact of warrant expiration on the underlying shares. It proposes several sample groups in which such impact may emerge different outcome. Overall, the hypotheses of there are significant price effect and abnormal trading volume around the warrant expirations cannot be rejected. The hypotheses of different price effect and trading volume in sub groups also have been confirmed. This study makes extensive of data from Taiwanese market and several sample groups; the empirical analysis can also serve as a means to improve academic knowledge of impact derivative expiration event on the underlying shares. We conclude that the feature of the sample set does generate different results and we also provider alternative explanations to the empirical outcome.

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Table 1 Population and Sample Covered Warrants Stratified -By Year of Expiration

Population consists of all single covered warrants. Sample consists of first time, and subsequently, expired warrants on individual share, from the market's inception (August 1997),until August 2003. Trading values in US$ (million). Exchange rates TW$/US$: 1997 (26.66), 1998 (33.44), 1999 (32.27), 2000 (31.23), 2001 (33.80), 2002 (34.58), 2003 (34.42). Source: Taiwan Stock Exchange (TSE) Fact Book, and authors' calculations.

Year	1998	1999	2000	2001	2002	2003
Population:						
- Total number of warrants	3	9	34	43	46	84
- Trading value of warrants	384	1,905	4,772	836	2,190	3,480
- Trading value of all TSE shares	890,994	907,813	977,632	543,045	632,651	595,902
Sample:						
- Number of sample warrants	3	8	24	28	31	44
(number of first time expired)	(3)	(2)	(12)	(8)	(7)	(18)
- Trading value of warrants	282	1,320	2,247	530	1,180	346
- Trading value of sample shares	182,898	306,244	247,565	194,689	169,145	78,875

Table 2 Daily Abnormal (ARs) and Cumulative Abnormal Returns (CARs) (150 days)

*Total sample consists of both, first time and subsequently expired warrants on the underlying shares. Average (mean) ARs and CARs within the event window in percentage terms. The level of significance for the two-tailed T test of mean = 0 vs. mean ≠ 0 indicated as:*** significant at 1% level; ** significant at 5% level; * significant at 10% level. Unreported results for the Sign test of median = 0 vs. median ≠ 0 total sample abnormal returns confirm results of the T-test for –10 at 10%. Unreported results for the Sign test of median = 0 vs. median ≠ 0 first time expired abnormal returns confirms results of the T-test for 2 at 5% level. Unreported results for the Sign test of median = 0 vs. median ≠ 0 subsequent expired abnormal returns confirms results of the T-test for –3,2,3 at 5% level. The sign tests for the CAR are all significant from zero during the event window for all three groups.*

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	Total sample		First time expired		Subsequent expired	
Day	**AR**	**CAR**	**AR**	**CAR**	**AR**	**CAR**
-10	-0.0144	-0.0144	-0.0181	-0.0181	-0.0124	-0.0124
-9	0.0739	0.0421	0.2038	0.1314	0.0001	-0.0087
-8	0.1177	0.1023	0.2004	0.2229	0.0707	0.0337
-7	0.0189	0.0980	0.0306	0.2083	0.0123	0.0353
-6	0.1031	0.1338	0.2039	0.2775**	0.0458	0.0521
-5	0.0238	0.1318	0.0436	0.2711**	0.0126	0.0527
-4	-0.1083	0.0811	-0.0455	0.2338**	-0.1440	-0.0057
-3	-0.0966	0.0417	0.0929	0.2516**	-0.2042**	-0.0775
-2	0.0663	0.0615	0.2978**	0.3365***	-0.0652	-0.0948
-1	-0.0016	0.0578	-0.0529	0.3024**	0.0275	-0.0812
0	0.0629	0.0741	0.2512**	0.3641***	-0.0441	-0.0907
1	0.0097	0.0737	-0.1396	0.3083**	0.0945	-0.0596
2	0.0207	0.0765	0.2952**	0.3781***	-0.1353	-0.0948
3	-0.0950	0.0484	-0.1154	0.3335***	-0.0834	-0.1136
4	-0.1368	0.0114	-0.1349	0.2874**	-0.1380	-0.1454
5	-0.0217	0.0056	-0.0075	0.2764**	-0.0298	-0.1482
6	0.1370	0.0387	0.1260	0.2987**	0.1433	-0.1091
7	-0.0036	0.0367	-0.0495	0.2786**	0.0225	-0.1007
8	0.1329	0.0662	0.1251	0.2999**	0.1373	-0.0665
9	-0.0258	0.0588	0.0488	0.3032**	-0.0682	-0.0801
10	0.1174	0.0830	0.2119	0.3421***	0.0638	-0.0642

Table 3 Daily Abnormal (ARs) and Cumulative Abnormal Returns (CARs) (150 days)

*Total sample consists of both, in and out-of-the-money expired warrants on the underlying shares. Average (mean) ARs and CARs within the event window in percentage terms. The level of significance for the two-tailed T test of mean = 0 vs. mean ≠ 0 indicated as*** significant at 1% level; ** significant at 5% level; * significant at 10% level. Unreported results for the Sign test of median = 0 vs. median ≠ 0 in the money sample abnormal returns confirm results of the T-test for 3 at 5%. Unreported results for the Sign test of median = 0 vs. median ≠ 0 out of the money group abnormal returns confirms results of the T-test for -1 at 5% level.*

	In the money sample		Out of the money sample	
Day	**AR**	**CAR**	**AR**	**CAR**
-10	0.0814	0.0814	-0.0166	-0.0166
-9	-0.2818	-0.1417	0.1731**	0.1107
-8	-0.0551	-0.1475	0.1594**	0.1824**
-7	-0.1004	-0.1779	0.0405	0.1782**
-6	-0.0498	-0.1814	0.1455	0.2245***
-5	-0.1036	-0.2079	0.0474	0.2243***
-4	-0.0981	-0.2295	-0.1281	0.1592**
-3	-0.2782	-0.3131**	-0.0492	0.1315
-2	0.1451	-0.2468	0.0366	0.1362
-1	0.3694**	-0.1173	-0.1163	0.0924
0	-0.0205	-0.1180	0.0919	0.1159
1	0.1150	-0.0798	-0.0104	0.1079
2	-0.1620	-0.1216	0.0815	0.1263
3	-0.3653**	-0.2148	-0.0317	0.1132
4	-0.3146**	-0.2888	-0.0880	0.0867
5	0.0323	-0.2715	-0.0504	0.0713
6	0.0283	-0.2566	0.1800**	0.1129
7	-0.0910	-0.2708	0.0067	0.1113
8	0.0905	-0.2428	0.1500	0.1427
9	-0.0486	-0.2476	-0.0069	0.1376
10	0.0714	-0.2260	0.1717**	0.1717**

Table 4 Average ARs and CARs Before and After Expirations (150 days)

*Total sample consists of both, first time and subsequently expired warrants on the underlying shares. Average (mean and median) AR and CAR, 10 days before expirations, and 10 days after expirations. Median returns reported in (brackets). P-values [in parentheses] indicate the level of significance for the differences in mean (t-test) and median (Wilcoxon test) AR and CAR, before and after expirations. Unreported results for Kruskal-Wallis test confirm reported results for differences between median returns. The level of significance for the two-tailed T, and Wilcoxon tests, for mean/median = 0 vs. mean/median ≠ 0 given as: *** significant at 1%; ** significant at 5%; * significant at 10%.*

	Total Sample			First time expired			Subsequent expired		
	N	**AR**	**CAR**	**N**	**AR**	**CAR**	**N**	**AR**	**CAR**
Before expiration	138	0.00 (0.02)	0.07(0.07)	50	0.10 (0.07)	0.22 (0.24)	88	-0.03(0.01)	-0.01(-0.01)
After expiration	138	0.02 (0.02)	0.05(0.06)	50	0.06 (0.05)	0.31 (0.30)	88	-0.03(0.01)	-0.10(-0.10)
During event window	138	0.02 (0.02)	0.04(0.06)	50	0.07 (0.05)	0.27(0.28)	88	-0.03(0.01)	-0.06(-0.08)
Difference (before-after)		-0.02 (0.0)	0.02(0.01)		0.04(0.02)	-0.09(-0.06)		0.00 (0.00)	0.09(0.09)
P-value for T-test		[0.90]	[0.20]		[0.01]	[0.01]		[0.97]	[0.00]
P-value for Wilcoxon test		[0.97]	[0.22]		[0.01]	[0.00]		[0.91]	[0.00]

	In the Money Sample			Out of the Money Sample		
	N	**AR**	**CAR**	**N**	**AR**	**CAR**
Before expiration	32	-0.04 (-0.08)	-0.19 (-0.18)	106	0.03 (0.04)	0.14 (0.15)
After expiration	32	-0.06 (-0.02)	-0.21 (-0.24)	106	0.05 (0.01)	0.12 (0.11)
During event	32	-0.05 (-0.05)	-0.19 (-0.21)	106	0.04 (0.04)	0.13 (0.13)
Difference		0.2 (-0.06)	-0.02 (-0.06)		-0.02 (0.03)	0.02 (0.04)
P-value for T-test		[0.77]	[0.27]		[0.73]	[0.30]
P-value for Wilcoxon		[0.86]	[0.25]		[0.75]	[0.17]

Panel B: Difference between first time expired group and subsequent expired group

Panel B presents the 2 sample T-test and nonparametric Wilcoxon test for the difference between the first time expiration group and the subsequent expiration group. The differences between the AR, CAR and Sign value for both groups are examined.

First time vs. Subsequent (AR)			First time vs. Subsequent (CAR)		
	N			**N**	
First	50	0.07 (0.05)	**First**	50	0.27 (0.29)
Subsequent	88	-0.01 (-0.01)	**Subsequent**	88	-0.06 (-0.08)
Difference		-0.08 (-0.04)	**Difference**		0.33(0.37)
P-value for T-test		[0.02]	**P-value for T-test**		[0.00]
P-value for Wilcoxon		[0.05]	**P-value for Wilcoxon test**		[0.00]

Panel C: Difference between in the money group and out of the money group

Panel B presents the 2 sample T-test and nonparametric Wilcoxon test for the difference between the in the money expiration group and the out of the money expiration group. The differences between the AR, CAR and Sign value for both groups are examined.

In vs. Out of the Money (AR)			In vs. Out of the Money (CAR)		
	N			**N**	
In the money	32	-0.05 (-0.05)	**In the money**	32	-0.19 (-0.21)
Out of the money	106	0.04 (0.04)	**Out of the money**	106	0.13 (0.13)
Difference		-0.09 (-0.09)	**Difference**		-0.32 (-0.34)
P-value for T-test		[0.05]	**P-value for T-test**		[0.00]
P-value for Wilcoxon		[0.04]	**P-value for Wilcoxon test**		[0.00]

Table 5 Relative Trading Volume Ratios

Panel A contents total sample consists of both, first time and subsequently expiration warrants on the underlying shares. RViB stands for average (mean and median) relative trading volume ratio100 days before the warrants expirations; RViA stands for the average (mean and median) relative trading volume ratio 100 days after the warrants expirations. Median RViB and RViA reported in (brackets). The ratio is presented in P-values [in parentheses] indicate the level of significance for the differences in mean (T-test) and median (Wilcoxon test) ratios before and after expirations.

Panel A: RViB and RViA for total, first time and subsequent expiration groups.

Sample Set	N	Total sample	N	First time	N	Subsequent
RViB	138	0.93. (0.63)	50	0.79 (0.52)	88	1.01 (0.73)
RViA	138	0.86 (0.59)	50	0.76 (0.45)	88	0.93 (0.65)
Difference (RViB-RViA)		0.09 (0.04)		0.03 (0.07)		0.08 (0.8)
P-value for T-test		[0.48]		[0.83]		[0.47]
P-value for Wilcoxon		[0.25]		[0.46]		[0.29]

Panel B: RViB and RViA for in the money and out of the money expiration groups.

Panel B consists in the money group and out of the money group. RViB stands for average (mean and median) relative trading volume ratio100 days before the warrants expirations; RViA stands for the average (mean and median) relative trading volume ratio 100 days after the warrants expirations. Median RViB and RViA reported in (brackets). The ratio is presented in P-values [in parentheses] indicate the level of significance for the differences in mean (T-test) and median (Wilcoxon test) ratios before and after expirations.

Sample Set	N	In the Money	N	Out of the Money
RViB	32	1.07 (0.75)	50	0.89 (0.57)
RViA	32	0.98 (0.62)	50	0.83 (0.58)
Difference (RViB-RViA)		0.09 (0.13)		0.06 (-0.01)
P-value for T-test		[0.67]		[0.58]
P-value for Wilcoxon		[0.36]		[0.48]

Panel C: Difference between first time expired group and subsequent expired group

Panel C presents the 2 sample T-test and nonparametric Wilcoxon test for the difference between the first time expiration group and the subsequent expiration group. The differences between the RViB and RViA values for both groups are examined.

First time vs. Subsequent	RViB		First time vs. Subsequent	RViA	
	N			N	
First	50	0.79 (0.52)	**First**	50	0.76 (0.45)
Subsequent	88	1.01 (0.73)	**Subsequent**	88	0.93 (0.65)
Difference		-0.22 (-0.19)	**Difference**		-0.17 (-0.20)
P-value for T-test		[0.14]	**P-value for T-test**		[0.22]
P-value for Wilcoxon		[0.03]	**P-value for Wilcoxon**		[0.06]

Panel D: Difference between in the money and out of the money expiration group

Panel D presents the 2 sample T-test and nonparametric Wilcoxon test for the difference between the in the money group and the out of the money expiration group. The differences between the RViB and RViA values for both groups are examined.

In vs. Out of the Money	RViB		In vs. Out of the Money	RViA	
	N			N	
In the Money	32	1.07 (0.75)	**In the Money**	32	0.98 (0.62)
Out of the Money	106	0.89 (0.57)	**Out of the Money**	106	0.83 (0.58)
Difference		0.18 (0.18)	**Difference**		0.15 (0.04)
P-value for T-test		[0.28]	**P-value for T-test**		[0.35]
P-value for Wilcoxon		[0.09]	**P-value for Wilcoxon**		[0.38]

Table 6 Daily Abnormal Trading Volume (AV) (150 days)

*Mean AV during the event window calculated as in equation 5 in percentage terms. The level of significance for the T- test for mean = 0 vs. mean 0, calculated as in equation 8, given as: *** significant at 1%; ** significant at 5%; * significant at 10%*

	Total sample	First time expired	Subsequent expired
Day	AV	AV	AV
-10	13.5472**	11.2918**	8.1606
-9	24.1182***	21.3236***	9.2537
-8	31.6304***	32.8577***	22.4018***
-7	27.2312***	25.8267***	18.1523***
-6	19.7551***	16.6162***	9.9881
-5	21.6121***	19.2811***	16.8522**
-4	13.5615**	10.9613**	10.5911
-3	4.6588	4.2817	-5.7145
-2	13.9917**	12.7555**	1.1524
-1	6.6597	5.6160	-12.9483**
0	20.2142***	18.9611***	0.2414
1	28.2714***	28.3478***	11.9108
2	27.3362***	28.6335***	12.4448
3	19.2705***	19.8536***	4.7892
4	5.2539	6.1024	-1.1800
5	0.9821	1.6700	-2.1431
6	4.8213	3.2691	4.4833
7	12.4308**	12.4724**	12.8889**
8	22.6926***	24.0656***	17.5790**
9	22.2574***	24.5014***	17.4323**
10	17.8934***	18.9171**	16.9640**

Table 6 Daily Abnormal Trading Volume (AV) (150 days)

*Mean AV during the event window calculated as in equation 5 in percentage terms. The level of significance for the T- test for mean = 0 vs. mean 0, calculated as in equation 8, given as: *** significant at 1%; ** significant at 5%; * significant at 10%*

	In the Money sample	Out of the Money
Day	**AV**	**AV**
-10	16.8534	12.5676
-9	0.0797	31.2407***
-8	3.3500	40.0098***
-7	4.0996	34.0850***
-6	1.4468	25.1798***
-5	17.0437**	22.9657***
-4	1.2301	17.2152 **
-3	-6.2936	7.9040
-2	2.7961	17.3089**
-1	-4.2990	9.9067
0	-3.0413	27.1047***
1	-2.3654	37.3489***
2	7.4582	33.2259***
3	-4.1237	26.2021***
4	-5.3785	8.4043
5	-5.1036	2.7853
6	-18.2801**	11.6662**
7	6.0285	14.3278**
8	4.4842	28.0877***
9	-2.0808	29.4687***
10	0.3557	23.0897**

Table 7 Average AVs Before and After Expirations (150 days)

*Total sample consists of both, first time and subsequently expired warrants on the underlying shares. Average (mean and median) AV, 10 days before expiration, and 10 days after expirations. Median abnormal trading volume are reported in (brackets). P-values [in parentheses] indicate the level of significance for the differences in mean (t-test) and median (Wilcoxon test) AR, before and after expirations. Results for both in the money and out of the money group are also reported below. Unreported results for Kruskal-Wallis test confirm reported results for differences between median returns. The level of significance for the two-tailed T, and Wilcoxon tests, for mean/median = 0 vs. mean/median ≠ 0 given as: *** significant at 1%; ** significant at 5%; * significant at 10%.*

Panel A: Average AVs Before and After Expirations

	Total Sample		First time expired		Subsequent expired	
	N	**AV**	**N**	**AV**	**N**	**AV**
Before expired	138	16.49(19.27)	50	16.08 (14.69)	88	7.79 (9.62)
After expired	138	17.68(16.87)	50	16.98(18.96)	88	8.67 (11.91)
During event	138	17.06(19.27)	50	16.55 (18.92)	88	8.25 (9.99)
Difference (before-after)		-1.19(2.40)		-0.90(-4.27)		-0.88(-2.29)
P-value for T-test		[0.77]		[0.83]		[0.83]
P-value for Wilcoxon test		[0.86]		[0.81]		[0.92]

	In the money sample		Out of the money sample	
	N	**AV**	**N**	**AV**
Before expired	32	3.63(-2.00)	106	21.84 (20.14)
After expired	32	2.12(-2.37)	106	21.97 (26.20)
During event	32	0.68(0.36)	106	21.91 (23.09)
Difference (before-after)		1.51(0.37)		-0.13(-6.06)
P-value for T-test		[0.10]		[0.98]
P-value for Wilcoxon test		[0.22]		[0.92]

Panel B: Difference between first time expired and subsequent expired group

Panel B presents the 2 sample T-test and nonparametric Wilcoxon test for the difference between the first time expired group and the subsequent expired group. The differences between the Abnormal trading volumes for both groups are examined.

First time vs. Subsequent	(Abnormal trading volume)	
	N	
First	50	16.55 (18.92)
Subsequent	88	8.25(9.99)
Difference		8.3(8.93)
P-value for T-test		[0.01]
P-value for Wilcoxon test		[0.01]

Panel C: Difference between in-the-money group and out-of-the-money group

Panel B presents the 2 sample T-test and nonparametric Wilcoxon test for the difference between the in-the-money group and out-of-the-money group. The differences between the Abnormal trading volumes for both groups are examined.

In vs. Out of the Money	(Abnormal trading volume)	
	N	
In of the Money	32	0.68 (0.36)
Out of the Money	106	21.91(23.09)
Difference		-21.35(-22.73)
P-value for T-test		[0.00]
P-value for Wilcoxon test		[0.00]