THE EFFECT OF OPTIONS INTRODUCTION ON UNDERLYING STOCKS FURTHER EVIDENCE FORM HONG KONG MARKET

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The Effect of Options Introduction on Underlying Stocks
Further Evidence from Hong Kong Market

Weerawut Treerattrakul

An Independent Study
Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science (Finance)

Master of Science Program in Finance
(International Program)
Faculty of Commerce and Accountancy
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May 2009

Thammasat University

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By

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On May, 2009

Advisor: ……

(Assoc. Prof. Dr. Kulpatra Sirodom)

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ABSTARCT

This paper investigates the impact of stock option introduction on underlying stocks characteristics in Hong Kong market from 1995 to 2008. The empirical results of this study suggest that stock options introduction cause negative price impact on underlying stocks immediately one day after stock options listing. The impact is permanent for at least thirty days after stock options introduction date. However, on average, stock options listing do not cause any significant change in volatility of underlying stock return and trading volume.

I. INTRODUCTION

According to Black and Scholes model (1973), based on complete market assumption, options are considered as a redundant security and able to be replicated by portfolio of underlying security and riskless bond. In reality, if market completeness assumption did not hold or there were other factors that can violate Black and Scholes assumptions, the interaction between options and securities would exist. Although, there have been number of theoretical and empirical studies examining the impact of options listing on the underlying securities so far, those still provided inconclusive conclusions in term of magnitude and direction of the impact.

While several empirical researches related to the effect of options introduction on underlying securities have been conducted in United States and other few European markets, the empirical evidence based on emerging market is quite small, especially in Asia market. In this study, the case of Hong Kong market is selected to investigate because of its active trading. Hong Kong market becomes one of the largest markets for stock options trading in Asia-Pacific region. HSBC was the first stock option listed by HKEx in 1995 and until year of 2008 there are total of 49 the stock options listed by HKEx. Compared to other derivative products launched by HKEx, stock options have been consistently welcomed by investors since its inceptions. Figure 1 presents contract volumes and percentage change of total by products form year of 2003 to 2008 conducted by the research center of HKEx. Form figure1, stock options have experienced significant volume growth over recent years. The volume increased from 26.3 million contracts in 2006/2007 to 58.8 million contracts in 2007/2008.

[Figure 1 is here]

In addition, compared to other stock options markets in different regions, stock options trading in Hong Kong market also experiences impressive growth rate based on trading volume, leading Hong Kong market to become one of the largest market for stock option trading in Asia-pacific region. Figure 2 shows percentage change of stock option trading volume in world markets, conducted by the World Federation of Exchange for the International Options Market Association (IOAM). According to the statistic, in 2007, the

trading volume of stock options in Hong Kong market is raised by 154% relative to in 2006 and accounted for 57% of total volume in Asia-Pacific region.

[Figure 2 is here]

In this paper, I try to explore further evidence whether there exists price, volatility, and trading volume impact after stock options introduction in Hong Kong market. Abnormal returns, volatility change, and trading volume change during the period surrounding options listing date are analyzed to find the impact caused by the stock options introduction. The results of this study would contribute to the research on this debatable issue by providing further evidence in emerging market. Furthermore, it will provide useful information to policy maker and regulators bodies about how newly listed stock options affect the market behaviors of underlying stocks and to investors who hold portfolio including the underlying stocks so that investors are able to adjust their portfolio according to the impact. The results of this study indicate that there exists negative price impact on a day after option listing. The cumulative average abnormal appears negative and significant two days before option listing. Also, the impact exhibits permanent at least thirty days after stock options listing. However volatility and trading volume do not have any effect from stock options listing.

II. LITERATURE REVIEW

Based on both theoretical and empirical analysis, the impacts of options introduction on the underlying securities have been extensively investigated for several years. However, there have been no consensus conclusions about the effect of initial option listing on underlying stocks.

Price effect

Three main perspectives have been developed so far to explain the impact of options introduction on underlying stocks. First view point is based on the market completion hypothesis. The hypothesis predicts an increase in stock price which results from a shift of overall aggregate demand of stocks in economy. Ross(1976) and Detemple and Selden(1991)

point out that in an incomplete market where stocks, call written on them , and a riskless bond are available for trade, options and underlying stocks will generally interact each others. The study assumes a given set of mean variance and two types of investors. Investors with a high risk assessment sell stocks and buy options to achieve for large value of stocks payoff. That is, they view options as a substitute for stocks. On the other hand, low risk assessment investors buy more stocks and sell options. Because the latter group of investors reacts stronger in the market, the net aggregate demand for stocks increases, leading to an increase in stock price. Moreover, Detemple and Jorion (1990) also suggest that since options are able to expand the pay off pattern faced by investors, when options are sequentially introduced to market, the magnitude of price movement should be mitigated because of market being more completed.

The second view point is based on short sale constraint hypothesis. The hypothesis predicts a decline in stocks price. Diamond and Verrecchia (1987) argue that when options are introduced, short sale constraint is more relaxed, leading underlying stocks price, on average, lower. Before options are introduced, stocks that are previously imposed by the short sale constraint adjust more slowly to bad news than to good news. Once options are listed, bearish investors are allowed to take advantage from negative information. Therefore, the speed of adjustment of stock prices to bad news tends to increase, causing underlying stock price, on average, decrease. This argument is consistent with the earlier study of Miller (1977) who suggests that short selling restrictions cause upward bias to asset price. When short selling restrictions are imposed, less negative information is reflected into prices since investors with relatively pessimistic price expectation are constrained to trade on their negative information. Also, empirical work of Figlewski (1981) shows that security prices with short selling constraint are too high relative to that with no short selling constraint.

Finally, more recently paper purpose the asymmetric information hypothesis. The hypothesis concerns about the effect of change in a level of asymmetric information in underlying asset market caused by options introduction. Faff and Hiller (2005) suggest that when options are listed, informed traders would migrate from underlying market to options market due to merit of leverage, lower transaction costs, and relative lack of restrictions. This

influx of informed trader from underlying market to options market would lead to lower level of asymmetric information faced by traders remaining in underlying market. Also, options introduction also encourages information flows since the activities in options market can be observed by traders in underlying market. This phenomenon cause the information impound into asset price more quickly. Therefore, abnormal returns of underlying securities surrounding date of option introduction would be strongly related to future expected return thanks to better information in the market.

Empirical studies also provide no consensus conclusions related to the effect of options introduction on underlying securities. For earlier studies, Branch and Finnerty (1981), Roa and Ma (1987), Conrad (1989), Detemple and Jorion (1990), Kim and Young (1991) examined price effect in US market by employing standard event study methodology and found positive price effect associated with option listing date. Later, using US data, Sorescu (1999) reported positive price effect before 1981 period and negative price effect after 1981 period, however, the reason behind the switch of the sign is still ambiguous. The previous empirical evidences based on other European markets are also inconclusive. Watt, Yadav and Draper (1992) and Faff and Hiller (2005) studied effect of option introduction on underlying securities in UK. Gjerde and Saettem (1995) used Norway data for testing. They all reported positive price effect related to option listing. Nevertheless, Kabir (1997) found negative price response in Netherland. Recently, when Asia markets play more roles for stock options trading, researches according to impact of options listing on underlying securities start gaining more interests in this region. Liu (2007) studied based on Japan market and Chen and Chang (2008) conducted the research based on Taiwan market. They both reported positive price effect which contrasts to the negative price effect reported by earlier studies in US after 1981 period.

Volatility effect

There are number of theoretical literatures supporting the hypothesis that options introduction may affect the volatility of underlying stocks returns. However, those of studies still provided no consensus on the direction and magnitude of effect. Stein (1987) suggests that speculation activities may lead to market instability. When options or futures market is

introduced more speculators would be induced to the market, leading to improve risk sharing but also changing the informational content of price. This would affects ability to make inferences based on current spot price of trader already in market. If prices were contaminated by misleading information content, volatility of the underlying asset returns would be enhanced. However, some studies claim that options introduction would result in market stability. Grossman (1988) suggested that options trading could reveal useful information about future trading intentions of investors. Thus, volatility of underlying assets would reduce when options are traded in market. The decline in volatility of underlying stocks is also supported by complete market hypothesis. Detemple and Jorion (1990) argued that when options is introduced in incomplete market, the net aggregate demand for underlying stocks increases, leading underlying stock price to increase. At the same time, Given that the stocks payoff is unaffected, the volatility of the stock rate of returns decreases so that the option introduction contracts stabilize the stock market.

Number of authors conducted empirical researches to find whether stock option introduction have any impact on underlying stocks volatility. Almost all of previous empirical results consistently indicate reduction of volatility of underlying stocks after option introduction. Conrad (1989), Detemple and jorion (1990), Hadded and Voorheis (1991), and Damodaran and Lim (1991) studied the effect of option listing on underlying stock volatility and documented a decline in volatility after options introduction. Consistent with earlier studies in US, later studies based on non-US market also show a reduction in volatility associated with option listing. Elfakhani and Chuadhury (1995) reported a decrease in volatility of underlying securities after options introduction in Canada. Later, the same result was confirmed by Alkeback and Hagelin (1998) in Sweden market. Compared to evidence in US and other developed markets, evidences in Asia market are relatively small. Chen and Chang (2008) reported that volatility decreases when option is introduced in Taiwan market. Liu (2007), on the other hand, found volatility hike in Japan.

Volume effect

For trading volume, based on information asymmetry hypothesis, informed traders prefer options market due to leverage benefit, low transaction costs, and relative lack of restrictions. When informed traders migrate from underlying stock market to options market, the level of asymmetric information in underlying market would be mitigated. The lower level of asymmetric information in underlying market result in reduction of adverse selection facing liquidity trader since liquidity trader in underlying market would lower their probabilities of their losses against informed trader due to a reduction of level of asymmetric information. This circumstance will attract more new investors to the underlying market and in turn lead to smaller spread and increase in trading volume.

Most of empirical results related to impact of options introduction on trading volume of underlying stocks reported an increase in trading volume of underlying stocks. Based on US market, Hayes and Tennenbaum (1979) and Skinner (1998) measured market adjusted trading volume change after options introduction and reported significant increase in trading volume of underlying stocks. More recently, Chang and Chen (2008) found an increase in trading volume in Taiwan market.

In summary, there exists no consensus in both theoretical and empirical literatures regarding to the impact of option introduction on underlying securities' characteristics. Also Most of the studies have been focused based on US market and other few developed markets, therefore; it is worthwhile extending empirical studies in other regions especially in Asia market where stock option trading enjoy impressive growth rate and become playing much more important role in the world market.

III. METHODOLOGY

Price effect

To examine whether there exists effect of options introduction on price of underlying securities, standard event study is employed. The null hypothesis of no impact of options introduction on stock prices is tested. Stock option introduction date is used as event date. The

estimation period is 120 trading days before the start of event period (t = -150 to -31), while event window extends from day -30 to day +30 relative to date of stock options introduction (day 0). The market model parameters are estimated by following market model over the estimation period by employing ordinary least squares regression method.

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

Where R_{it} is the continuously compounded returns of stock *i* in period *t*. R_{mt} is continuously compounded returns of market index. All Ordinaries Index which represents overall performances of all Hong Kong shares and H-shares is used to calculated market index returns. α_i and β_i are estimated market model parameters. ε_{it} is the random disturbance term for stock *i* in period *t* with zero expected value and constant variance. After obtaining market model parameters, then expected return is calculated according to following equation.

$$E(R_{it}) = \alpha_i + \beta_i E(R_{mt}) \quad (2)$$

Where R_{mt} is continuously compounded return of market index in event period. α_i and β_i are the estimated parameters obtained from equation (1). Difference between expected return from equation (2) and actual return in event period, are calculated to represent abnormal returns over event period.

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt}) \quad (3)$$

Where AR_{it} are abnormal returns of each underlying stock on each day over event period. Abnormal returns of each underlying stock on each day over event period are averaged across underlying stocks to obtain average abnormal returns *(AAR)* and then averaged abnormal returns are accumulated over event periods to obtain cumulative averages abnormal returns *(CAAR)*. The averaged abnormal returns and cumulative averaged abnormal returns are computed as following questions.

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it} \qquad i = 1,2,\dots,N \quad and\ t = -30,\dots,+30 \tag{4}$$

$$CAAR_k = \sum_{t=s}^{s+k-1} AAR_t \qquad 2 \le K \le 39 \quad and\ t,s = -30,\dots,+30 \tag{5}$$

Where AAR_t is averaged abnormal returns on each day over event period. $CAAR_k$ is cumulative averaged abnormal returns over the event period.

To examine whether abnormal returns are statistically significantly different from zero, the parametric test statistic of Boehmer et al.(1991) is performed to deal with the problem of the event-induced variance change experienced by samples.

$$t(SAR) = \left(\sum_{i=1}^{n} SAR_{it}\right).\frac{1}{\sqrt{N}} \tag{5}$$

$$t(SCAR) = \left(\sum_{i=1}^{n} SCAR_{ik}\right).\frac{1}{\sqrt{N}} \tag{6}$$

Where SAR_{it} is abnormal returns standardized by standard deviation of abnormal returns of stocks i in estimation period. $SCAR_{ik}$ is cumulative abnormal return standardized by standard deviation of abnormal returns of stocks i in estimation period. N is number of underlying stocks. For robustness, non-parametric Wilcoxon signed-rank test is also performed to mitigate the problem of small sample.

Volatility effect

To examine whether options introduction affects variance of underlying stocks, null hypothesis of no change in volatility after options listing date is tested by measuring the ratio of adjusted volatility (AV). Following Alkeback and Hagelin (1998), the test is conducted by calculating variance of each stock for 90, 180, and 270 trading days on either side of stock options listing date. To control for contemporaneous change in market volatility, volatility of underlying stocks returns is adjusted by dividing each standard deviation of stock returns for both before and after option introduction period by corresponding market standard deviation. All Ordinaries Index which represents performance of all stocks trading in Hong Kong market

is used to calculate market return and standard deviation of market return. Adjusted variance ratio (AVR) is then calculated by dividing adjusted volatility of each stock after option listing by adjusted volatility of each stock before options listing. Adjusted volatility ratio which less than one indicates a decrease in volatility of underlying stocks, while adjusted volatility ratio which greater than one indicates an increase in volatility of underlying stock. Wilcoxon signed-rank test is employed in order to deal with small samples problem.

In addition to measure the ratio of adjusted variance, alternative approach can be employed to test impact of options introduction on volatility of underlying stocks. Following the spirit of Schwert (1989 and 1990) and Schwert and Seguin (1990), market model in volatility with dummy variable is used to measure a shift in mean of volatility after stock options listing date. The model is written as following

$$r_{it}^2 = a_i + b_i r_{mt}^2 + c_i D_t + \varepsilon_{it} \quad (7)$$

Where r_{it}^2 and r_{mt}^2 are volatility of stock returns and volatility of market returns respectively, assuming that daily mean of stock and market returns are closed to zero. D_t is dummy variable which equal to one in period after options listing and zero otherwise. ε_{it} is random disturbance term for each stock. c_i of each stock is obtained and the cross-sectional t-statistic is calculated for average of c_i coefficient to test the null hypothesis of no significant change in volatility of underlying stocks, on average. The negative value of average of c_i parameters indicates a decrease in volatility of underlying stock returns, on average, in post listing period of stock options listing and positive value suggests an increase in volatility of stock returns, on average, in post listing period of stock options listing.

Volume effect

To investigate whether there is any impact of options introduction on trading volume of underlying stocks, the null hypothesis of no impact of options introduction on trading volume of underlying stock is investigated. The similar methodology to previous variance analysis is employed to test this null hypothesis based on 90, 180, 270 days on either side of stock

options introduction date. First, following Liu (2007), daily trading volume of each stock is standardized by corresponding number of share outstanding to account for change number of share outstanding available for trading. Then, trading volume ratio is calculated by dividing mean of standardized trading volume after options listing date by mean of standardized trading volume before options listing date. Trading volume ratio which is less than one indicates a decrease in trading volume of underlying stocks, while trading volume ratio which is greater than one indicates an increase in trading volume of underlying stocks after options listing. Finally, to mitigate the small sample problem, Wilcoxon signed-rank test is performed to test the null hypothesis of no change in trading volume after option listing date.

Alternatively, the method similar to Faff and Hiller (2005) can also be used to test the impact of options listing on trading volume of underlying stocks. The model is written as following

$$Ln(SV_{it}) = a_i + b_i D_t + \varepsilon_{it} \quad (8)$$

Where $Ln(SV_{it})$ is natural logarithm of trading volume standardized by number of share outstanding of each stock. D_t represents dummy variable which is one if the trading volume is in after option listing period, and zero otherwise. ε_{it} is the random disturbance term for each stock. The estimated b_i form equation (8) of each security is then averaged over the full samples. The cross-sectional *t*-statistic is calculated for average of those of estimated coefficients to test the null hypothesis of no significant change in trading volume of underlying stocks caused by options introduction. Negative sign of estimated b_i indicates a decline in median[1] of standardized trading volume and positive sign of estimated b_i indicates an increase in median of standardized trading volume after option listing date.

[1] According to Liu (2007), for trading volume distribution, the mean is considerably larger than the median, indicating positive skewness in general, as a result median is more reliable for measurement.

IV. INSTITUTIONAL DETAIL AND DATA

HKEx equity options

Stock options were first introduced on HKEx on September 8, 1995 to satisfy the hedging objective and various needs for market participants. HKEx selects underlying stocks based on liquidity criteria. Basically, the stocks eligible for options will generally be stocks which have large number of shares in public hands and large number of shareholders. Until year of 2008, American style Calls and Puts series have been simultaneously introduced on 49 underlying securities for three-month maturities and traded via an automated electronic trading system. In order to promote liquidity, HKEx operates a market maker system for stock options market. There are five expiry months in total including the three nearest months as well as the following two quarterly expiry months. At least five strike prices for new series stock options of each expiry month are launched in order to ensure that there are always at least two series out-of-the money, one series at-the-money and two series in-the-money for each type (call or put). The expiry day is a business day immediately before the last business day of the expiry month with trading hours of 10.00 am -12.30 am and 2.30 pm – 4.00pm.

The sample

This study is based on all stock options which have been listed form its inception in September 1995 to December 2008 by Hong Kong stock exchange. During this period, American style calls and puts options have been simultaneously listed on total of 49 underlying securities. In order to test the price effect hypothesis, daily return data of at least 120 days before options listing date is required. However there are 10 underlying stocks which were listed on the Exchange just few weeks before their options listing date so those stocks are excluded from the full sample, remaining the final sample of 39 stock options listings. The date of stock options listing is obtained from HKEx fact book 2008.

[Table I is here]

[Table II is here]

Table I represents the name of underlying stocks and their listing date. The time profile of options introduction over 13 years is presented in table II. Most of stock options are listed in

1995 and 2001. Underlying stocks are both Hong Kong shares and H-shares type which refer to shares of companies incorporated in mainland China but traded on Hong Kong stock Exchange. All underlying stocks are constituents of All ordinaries index which is a bench mark for measuring the performance of all stocks trading in Hong Kong market. For a final sample of underlying stocks, daily price, daily trading volume, and number of share outstanding series are retrieved from the *Datastream,* while All ordinaries index series is obtained from HKEx web site.

V. EMPIRICAL RESULTS

Price effect

Table III reports averaged abnormal returns and cumulative averaged abnormal returns during the period of 30 days before and after stock options listing date. The parametric test of Boehmer et.al. (1991) and non-parametric Wilcoxon signed-ran

k test are reported for testing null hypothesis of no significant averaged abnormal returns and cumulative averaged abnormal returns on each day over event window period.

[Table III is here]

Form table III, on introduction date, there exist negative averaged abnormal returns, however, it is insignificantly different from zero at any confidence level. Options introduction seem to have an impact on underlying stocks on few days immediately after options introduction date. Negative average abnormal returns become significantly different from zero at 90% and 99% confidence level, according to Wilcoxon signed-rank test, on a day and two days after options introduction date respectively. Moreover, the negative price impact tends to be permanent. Cumulative averaged abnormal returns reported from table III remain negative at least thirty trading days with more than 95% confidence level for 26 out of 30 days after option listing date.

The result suggests that stock options introduction in Hong Kong market , on average, have negative impact on price of underlying stocks which is consistent with theory based on short selling constraint suggested by Miller (1977) and Diamond and Verrecchia (1987).The

stock options introduction might lead to more relaxed short sale constraint and investors could trade based on bad news. As a result, securities price will reflect to bad news more quickly comparing to period before options introduction. The greater speed of bad news incorporated into stocks price would cause price, on average, decline. The negative price effect in this study is also consistent with the empirical studies of Sorescu (1998) and Watt, Yadav, and draper (1992) which also reported negative effect of stock options introduction on price of underlying securities in US market based on observation in post 1981 period and in UK market respectively. However, the result is contradict to the empirical studies of Conrad (1989), Detemple and Jorion (1990), and Gjerde and Saettem (1995) which documented positive impact of stock options listing on price of underlying securities. Compared to the studies in the same region, the result of this study is inconsistent with studies of Liu (2007) based on Japan market and that of Chen and Chang (2008) based on Taiwan market. Both authors found positive price impact on introduction date. While long term positive price effect is found in the study of Liu (2007), short term price effect is found in the study of Chen and Chang (2008).

Volatility effect

Table IV represents adjusted volatility ratios of underlying stocks for three different windows including 90, 180, 270 days on either side of options introduction date.

[Table IV is here]

According to null hypothesis of no change in volatility of underlying stocks returns, mean and median of adjusted volatility ratios are expected to be unity. From table IV, median ratios of adjusted volatility for all of three windows are less than unity, indicating that adjusted volatility of underlying stocks decrease after options introduction. Furthermore, while mean ratio of adjusted volatility for event window of 270 and 180 days appear less than one, indicating a decrease in adjusted volatility in corresponding windows, mean ratio of adjusted volatility for event window of 90 days period appear greater than one, indicating that options introduction cause an increase in volatility of underlying stocks. However, *p*-value based on the Wilcoxon signed-rank test for all three windows of both median and mean ratio of adjusted volatility are greater than 90% confidence level so the null hypothesis of no change

in volatility around option listing date is failed to reject at 90 % confidence level. In other words, there is no statistically significant change, on average, in volatility of underlying stocks for all three tested windows.

[Table V is here]

For market model in volatility with dummy variable in equation (7), the null hypothesis of zero of average of c_i parameter is tested. Table V reports average of estimated parameters of market model in volatility. From table V, on average, underlying stocks experience a decline in volatility after options introduction. Averaged c_i parameter is negative for two out of three windows, 270 and 180 days event window, indicating that after controlling for volatility of market return, the mean of volatility of underlying stock return tends to decrease. However, the null hypothesis of no change in volatility of underlying stocks return after option listing is failed to reject at even 90% confidence levels for all three tested windows. Thus, the result exhibits lack of significant change of volatility of underlying stock returns based on market model in volatility.

In summary, the result from both methods provides consistent evidence of no impact of options listing on volatility of underlying stocks in Hong Kong market. Compared to other previous results, no impact of options listing on volatility of underlying stocks in this study is consistent with empirical studies of Gjerde and Saettem (1995) ,Kabir (1997), and Chen and Chang (2008) who conducted the researches based on Norway, Netherland, and Taiwan market respectively.

Volume effect

To investigate change in trading volume of underlying stocks when stock options are listed in market, trading volume ratio is calculated and tested whether there exists significant change surrounding options listing date. Table VI represents trading volume ratios for underlying stocks in three different windows including 90, 180, 270 days on either side of options introduction date.

[Table VI is here]

The result shows that mean and median of trading volume ratio for all three windows are greater than unity, meaning that standardized trading volume tends to increase after stock options listing. However, there is no evidence of significant change in trading volume after options listing based on the Wilcoxon signed-rank test for all of three tested windows. *p*-value are all greater than 90% confidence level so the null hypothesis of no change in standardized trading volume surrounding options introduction date cannot be rejected at 90% confidence level.

[Table VII is here]

For the OLS regression with dummy variable, the null hypothesis of average of coefficient of dummy variable b_i is tested whether it is statistically different from zero. Table VII exhibits averaged of estimated parameters for all three different windows. From table VII, It can be seen that the averaged b_i is positive for all three windows, indicating that, on average, trading volume of underlying stocks seems to increase after stock options introduction. However high *p*-value for all three windows indicates that there is insignificant change in trading volume of underlying stocks at any level of significance. Thus, the result again clearly provides evidence of no impact of stock options listing on trading volume of underlying stocks. Similar to the result of studies of Damodaran and Lim(1991a) and Chamberlian, Cheung, and Kwan(1993) , based on United Stated and Canadian market respectively, this result suggests that stock options introduction does not alter trading volume of underlying stocks in Hong Kong market.

VI. CONCLUSION

Impact of options introduction on underlying stocks characteristics has been extensively investigated for several years in different markets. Both theoretical and empirical studies still provided no conclusive conclusion about the effect of options introduction on underlying stocks. The lack of empirical evidences for emerging markets and an active trading of stock options in Hong Kong market are main motivations for selecting Hong Kong market to study. The empirical results based on Honk Kong market indicates that equity options introduction leads to negative impact on price of underlying equity. Also, the negative price effect tends to

be permanent at least thirty trading days after options listing date. This result is consistent with the hypothesis related to short sales constraint. In the period of no allowance of short selling, stock prices are likely to be upward biased since traders cannot trade according to bad news. When options are listed, short sale constraint is more relaxed so the stocks that are previously imposed by the short sale constraint reflect bad news more quickly, leading stock prices, on average, decline. For volatility effect, the result of this study based on both measurement of change in adjusted volatility ratio between pre and post of options introduction period and market model in volatility reveals no evidence of effect of stock options listing on volatility of underlying stocks. For trading volume effect, there is no evidence of change in trading volume of underlying stocks when we compare mean of standardized trading volume between pre and post options listing period. Also, the same result is confirmed when OLS regression with dummy variable is employed.

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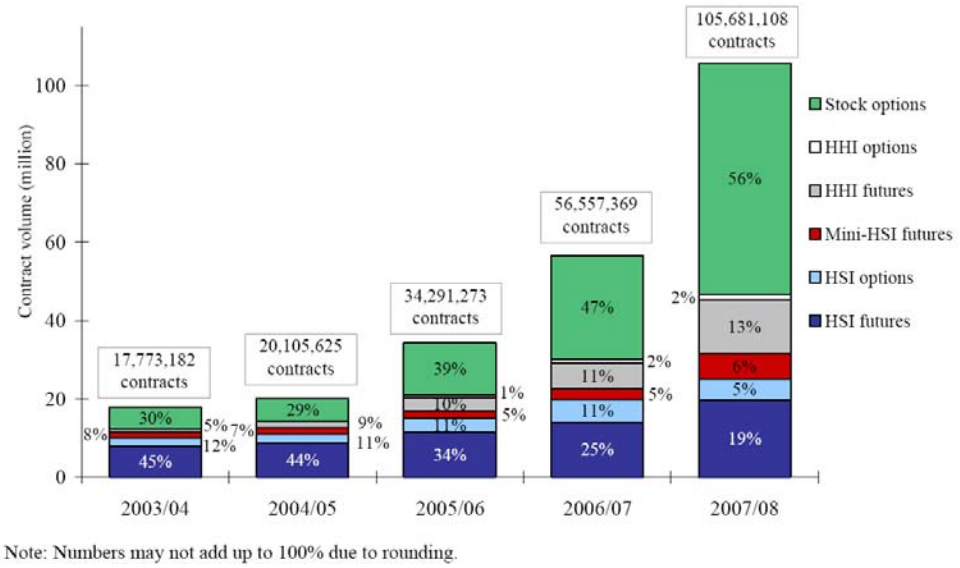

Note: Numbers may not add up to 100% due to rounding.

Figure 1[2]. The contract volume and percentage of total of derivative products trading in Hong Kong market.

[2] Figure 1 is from HKEx website : *www.hkex.com.hk.*

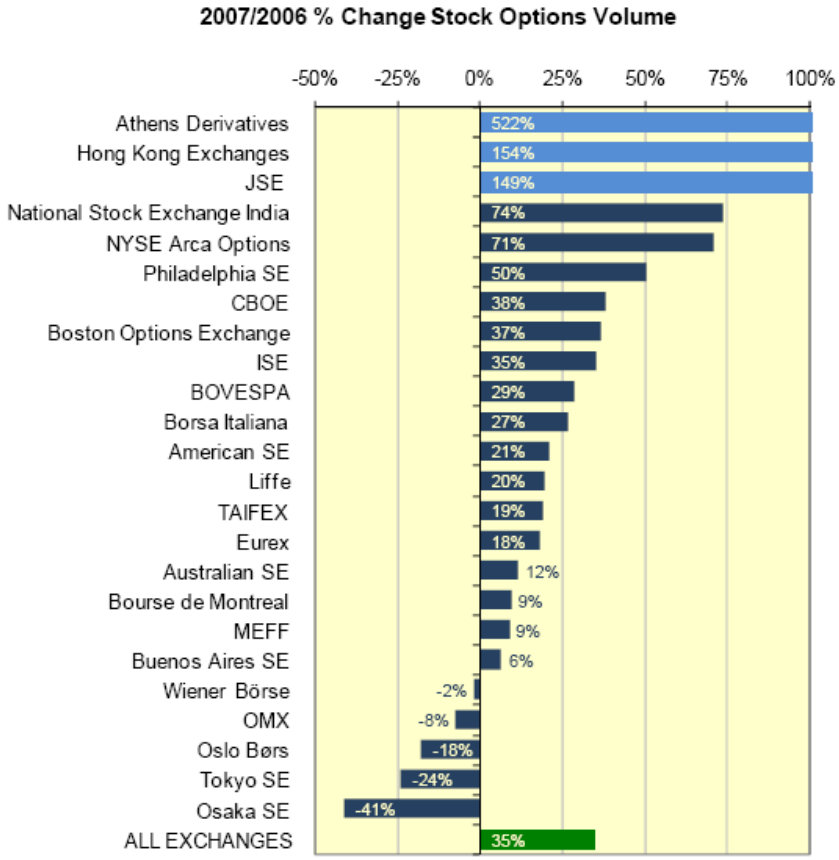

Figure 2[3]. Percentage change of trading volume of stock options trading in world markets in 2007/2006, surveyed by the World Federation of Exchange for The International Options Market Association (IOAM).

[3] Figure 2 is from IOMA derivatives market survey 2007.

Table I[4]

Stock options listing in Hong Kong market

Underlying stocks	Code	Date of listing	Lot size (share)
Aluminum Corporation of China Limited	ALUM	14/6/2004	2000
Bank of China Limited	BOCH	3/7/2006	1000
Bank of Communications Co., Ltd.	BOCC	7/11/2005	1000
The Bank of East Asia, Limited	BEAA	8/1/2001	200
BOC Hong Kong (Holdings) Limited	BOC	17/3/2003	500
China Construction Bank Corporation	CCBN	19/12/2005	1000
China Communications Construction Company Limited	CCON	19/3/2007	1000
China Coal Energy Company Limited	CCEC	3/9/2007	1000
China Mobile Limited	CHT	15/5/1998	500
China Unicom (Hong Kong) Limited	UNIC	27/8/2001	2000
CITIC Pacific Limited	CITP	23/10/1995	1000
Cheung Kong (Holdings) Limited	CHGK	25/9/1995	1000
Cheung Kong Infrastructure Holdings Limited	CKIH	27/8/2001	1000
China Life Insurance Company Limited	CLS	14/6/2004	1000
CLP Holdings Limited	CLIG	18/12/1995	500
China Merchants Bank Co., Ltd.	CMBC	27/10/2006	500
CNOOC Limited	CNOO	22/7/2002	1000
Cathay Pacifi c Airways Limited	CATH	27/8/2001	1000
China Petroleum & Chemical Corporation	CHPE	22/7/2002	2000
China Railway Construction Corporation Ltd.	CHNR	10/6/2008	500
China Railway Group Ltd.	CHRL	10/6/2008	1000
China Shenhua Energy Co. Ltd.	CSHE	10/6/2008	500
China CITIC Bank Corporation Limited	CBCC	3/9/2007	1000
China Telecom Corporation Limited	CTC	14/6/2004	2000
Denway Motors Limited	DENW	11/7/2005	2000
Esprit Holdings Limited	ESPR	11/7/2005	100
Foxconn International Holdings Limited	FOXC	19/3/2007	1000
Hong kong Electric Holdings Limited	HKEL	16/2/1998	500
Hong Kong Exchanges and Clearing Limited	HKEX	27/8/2001	100
HSBC Holdings Plc.	HSBC	8/9/1995	400
The Hong Kong and China Gas Company Limited	HKCG	27/8/2001	1000
Henderson Land Development Company Limited	HELD	18/12/1995	1000
Huaneng Power International, Inc.	HPI	22/7/2002	2000
Hang Seng Bank Limited	HSBA	9/12/1996	100
Hutchison Whampoa Limited HWL	HUTI	18/12/1995	1000
Industrial and Commercial Bank of China Limited	ICBC	27/10/2006	1000
Johnson Electric Holdings Limited	JNEL	27/8/2001	500
Jiangxi Copper Company Limited	JCOP	3/9/2007	1000
Li & Fung Limited	FUNG	27/8/2001	2000
MTR Corporation Limited	MTRC	27/8/2001	500
New World Development Company Limited	NWDV	5/8/1996	1000
Ping An Insurance (Group) Company of China, Ltd.	PING	7/11/2005	500
PCCW Limited PCC	TRIC	26/6/2000	1000
Petro China Company Limited	PECH	27/8/2001	2000
PICC Property and Casualty Company Limited	PICC	19/3/2007	2000
Sun Hung Kai Properties Limited	SHKP	18/12/1995	1000
Swire Pacifi c Limited ‘A’	SWPA	9/10/1995	500
Tracker Fund of Hong Kong	TFHK	27/3/2000	500
The Wharf (Holdings) Limited	HKWH	5/8/1996	1000

[4] This table is from HKEx webstie: *www.hkex.com.hk.*

Table II

Time profile of stock options listing in Hong Kong market

Year	Number of listings	Year	Number of listings
1995	8	2002	3
1996	3	2003	1
1997	0	2004	3
1998	2	2005	5
1999	0	2006	3
2000	2	2007	6
2001	10	2008	3
		Total	49

Table III

Averaged and Cumulative averaged abnormal returns, t-Statistics, and p-values around stock options introduction date.

The standard event study is employed to obtain average abnormal returns and cumulative average abnormal returns for each underlying stock in event period consisting of thirty days before plus thirty days after option listing date. The event date is the day by which stock option is introduced. The market model parameters are estimated in estimation period of 120 days immediately before event period.

Day	AAR		*p*-value	*p*-value[a]	CAR		*p*-value	*p*-value[a]	(%) Positive[b]
-30	0.0012		0.844	0.337	0.0012		0.844	0.337	58.3%
-29	-0.0003		0.608	0.758	0.0009		0.855	0.590	47.2%
-28	-0.0040		0.362	0.264	-0.0031		0.611	0.666	47.2%
-27	-0.0037		0.123	0.170	-0.0068		0.242	0.238	38.9%
-26	-0.0001		0.655	0.449	-0.0069		0.201	0.321	38.9%
-25	-0.0039		0.297	0.133	-0.0108		0.130	0.142	41.7%
-24	0.0001		0.914	0.866	-0.0106	*	0.162	0.100	50.0%
-23	-0.0006		0.612	0.633	-0.0112	*	0.127	0.078	47.2%
-22	0.0021		0.768	0.440	-0.0092		0.207	0.386	58.3%
-21	0.0030	*	0.025	0.056	-0.0061		0.504	0.666	61.1%
-20	0.0040		0.104	0.278	-0.0021		0.894	0.975	55.6%
-19	0.0051		0.277	0.487	0.0029		0.870	0.758	50.0%
-18	-0.0031		0.108	0.271	-0.0002		0.818	0.854	41.7%
-17	-0.0043	*	0.203	0.063	-0.0045		0.530	0.890	30.6%
-16	-0.0015		0.678	0.497	-0.0060		0.441	0.611	44.4%
-15	-0.0038		0.406	0.314	-0.0098		0.318	0.459	41.7%
-14	-0.0007		0.905	0.963	-0.0104		0.362	0.478	50.0%
-13	-0.0023		0.321	0.926	-0.0128		0.288	0.487	55.6%
-12	-0.0028		0.105	0.244	-0.0155		0.188	0.600	38.9%
-11	-0.0029		0.389	0.321	-0.0185		0.145	0.337	44.4%
-10	0.0013		0.856	0.926	-0.0171		0.158	0.337	44.4%
-9	-0.0024		0.889	0.794	-0.0196		0.129	0.196	50.0%
-8	-0.0002		0.830	0.988	-0.0198		0.124	0.244	52.8%
-7	0.0001		0.695	0.926	-0.0196		0.155	0.404	55.6%
-6	-0.0003		0.972	0.770	-0.0200		0.146	0.431	50.0%
-5	0.0020		0.706	0.747	-0.0179		0.213	0.413	44.4%
-4	-0.0053		0.680	0.951	-0.0232		0.210	0.213	50.0%
-3	-0.0024		0.461	0.890	-0.0255		0.142	0.170	55.6%
-2	-0.0048		0.352	0.644	-0.0304	**	0.081	0.044	47.2%
-1	-0.0008		0.640	0.579	-0.0312	**	0.065	0.043	41.7%
0	-0.0038		0.282	0.191	-0.0350	**	0.057	0.025	38.9%
1	-0.0042	*	0.363	0.058	-0.0392	**	0.044	0.019	36.1%
2	-0.0086	***	0.019	0.004	-0.0478	***	0.014	0.004	33.3%
3	-0.0016		0.967	0.666	-0.0494	***	0.021	0.010	50.0%
4	0.0041		0.075	0.185	-0.0453	***	0.042	0.010	61.1%
5	0.0032		0.314	0.208	-0.0422	*	0.076	0.056	58.3%
6	-0.0024		0.668	0.590	-0.0446	**	0.067	0.048	41.7%
7	0.0004		0.367	0.517	-0.0442	*	0.084	0.052	55.6%

Table III — *Continued*

Day	AAR		*p*-value	*p*-value[a]	CAR		*p*-value	*p*-value[a]	(%) Positive[b]
8	-0.0016		0.805	0.478	-0.0458	*	0.098	0.068	41.7%
9	0.0011		0.811	0.951	-0.0447	**	0.110	0.041	47.2%
10	-0.0026		0.041	0.175	-0.0473	**	0.068	0.022	38.9%
11	-0.0044		0.168	0.114	-0.0517	**	0.043	0.018	38.9%
12	-0.0077		0.123	0.306	-0.0594	***	0.016	0.005	47.2%
13	0.0029		0.725	0.497	-0.0564	***	0.012	0.005	52.8%
14	0.0016		0.608	0.723	-0.0548	**	0.029	0.023	47.2%
15	-0.0014		0.437	0.723	-0.0563	**	0.028	0.038	47.2%
16	0.0007		0.686	0.633	-0.0556	**	0.035	0.046	58.3%
17	-0.0011		0.702	0.208	-0.0567	**	0.026	0.050	47.2%
18	0.0016		0.932	0.866	-0.0551	*	0.024	0.090	47.2%
19	-0.0075	**	0.036	0.011	-0.0626	**	0.010	0.013	22.2%
20	-0.0034		0.418	0.644	-0.0660	***	0.007	0.006	47.2%
21	0.0069		0.144	0.156	-0.0591	**	0.013	0.010	63.9%
22	-0.0040		0.588	0.440	-0.0631	***	0.012	0.007	36.1%
23	0.0022		0.976	0.611	-0.0609	**	0.014	0.011	50.0%
24	0.0004		0.585	0.337	-0.0605	**	0.021	0.014	63.9%
25	-0.0040		0.471	0.202	-0.0646	**	0.019	0.011	38.9%
26	0.0035		0.569	0.794	-0.0611	**	0.023	0.029	44.4%
27	-0.0009		0.727	0.449	-0.0620	**	0.022	0.021	44.4%
28	-0.0038		0.216	0.202	-0.0658	**	0.019	0.015	36.1%
29	0.0030		0.053	0.306	-0.0627	**	0.037	0.020	50.0%
30	-0.0034		0.233	0.180	-0.0661	**	0.025	0.011	44.4%

[a] Refers to the Wilcoxon signed-rank test.

[b] Percentage of underlying stocks with positive abnormal returns.

***, **,* indicates statistical difference from zero at 1,5,10 percent levels, respectively, according to Wilcoxon signed-rank test.

Table IV

Change in adjusted volatility of underlying stocks

The adjusted volatility is defined as standard deviation of underlying stock returns standardized by corresponding standard deviation of market returns. Adjusted volatility ratio is the adjusted volatility after options introduction divided by adjusted volatility before options introduction. The adjusted volatility ratio is calculated based on 270, 180, and 90 days windows.

	Listing	Adjusted volatility ratio		
Firm	**date**	**270**	**180**	**90**
ALUM	06/14/04	0.9972	1.0710	1.2064
BEAA	01/08/01	0.8276	0.8855	1.0044
BOC	03/17/03	-	-	1.1835
CATH	08/27/01	1.6199	1.7039	1.6403
CCEC	09/03/07	-	-	1.0146
CHGK	09/25/95	1.0238	0.9209	0.9161
CHPE	07/22/02	1.1079	0.9660	0.7373
CHRL	06/10/08	-	-	-
CHT	05/15/98	-	-	1.4089
CITP	10/23/95	0.9459	0.9063	1.2670
CKIH	08/27/01	0.8233	0.8676	0.7953
CLIG	12/18/95	0.8869	0.7710	0.6773
CLS	06/14/04	-	-	1.1348
CNOO	07/22/02	1.1985	0.8176	0.6878
CSHE	06/10/08	-	-	-
CTC	06/14/04	0.9694	0.9837	0.9754
DENW	07/11/05	0.8771	1.1893	1.0371
ESPR	07/11/05	0.7711	0.8043	0.7882
FOXC	03/19/07	0.7002	0.5176	0.9708
FUNG	08/27/01	0.9513	0.8677	0.7798
HELD	12/18/95	1.0443	0.9814	0.8266
HKCG	08/27/01	0.8565	0.7297	0.7707
HKEL	02/16/98	0.9639	1.0477	0.9587
HKEX	08/27/01	1.1830	1.1405	1.1271
HKWH	08/05/96	0.9526	1.1996	1.2366
HPI	07/22/02	1.3049	0.9691	0.8720
HSBA	12/09/96	0.9449	1.0073	0.8969
HSBC	09/08/95	1.1342	1.0397	0.8792
HUTI	12/18/95	1.0298	0.9407	0.8452
JCOP	09/03/07	0.9225	0.8373	0.8101
JNEL	08/27/01	1.0958	1.0398	1.0021
MTRC	08/27/01	-	1.0336	0.9472
NWDV	08/05/96	1.0275	1.1865	0.9263
PECH	08/27/01	0.6973	0.6648	0.7205
PICC	03/19/07	0.8909	0.7792	1.1169
PING	11/07/05	1.2831	1.4425	1.8812
SHKP	12/18/95	0.9640	0.8460	0.7524
SWPA	10/09/95	1.0081	1.0184	1.1933
TRIC	06/26/00	0.6917	0.8858	1.2003
UNIC	08/27/01	0.8117	0.6976	0.7046
Mean ratio		0.9851	0.9635	1.0051
Median ratio		0.9639	0.9534	0.9530
SD		0.1914	0.2204	0.2619
N		33	34	40
Number of ratio > 1		13	13	17
p-value[a]		0.2263	0.115	0.5699

[a] Refers to the Wilcoxon signed-rank test.

— data is not available for the entire period.

Table V

Market model in volatility, with option listing as dummy variable

Model Estimated: $r_{it}^2 = a_i + b_i r_{mt}^2 + c_i D_i + \varepsilon_{it}$ where r_{it}^2 and r_{mt}^2 are stock returns volatility and market returns volatility respectively, assuming that daily mean of stock and market returns are closed to zero. D_i is dummy variable which equal to one in period after options listing and zero otherwise. ε_{it} is the random disturbance term for each stock. The model is estimated in 270, 180, and 90 days windows Null hypothesis tested Ho: averaged $c_i = 0$

Estimated	**Event window**					
parameter	**270**		**180**		**90**	
Averaged a_i	0.000379	***	0.000342	***	0.000252	***
	(3.744)		(4.837)		(4.970)	
	[0.001]		[0.001]		[0.001]	
Averaged b_i	1.461500	***	1.459200	***	1.583600	***
	(7.035)		(6.680)		(6.768)	
	[0.000]		[0.000]		[0.000]	
Averaged c_i	-0.000126		-0.000070		0.000039	
	(-1.522)		(-1.345)		(1.143)	
	[0.139]		[0.188]		[0.261]	

***, **,* indicates statistical difference from zero at 1,5,10 percent levels, respectively.
t-statistics presented in parentheses and *p*-value presented in brackets respectively.

Table VI

Change in trading volume of underlying stocks

The trading volume of each underlying stock is standardized by corresponding number of share outstanding. Trading volume ratio is mean of standardized trading volume after options listing divided by mean of the standardized trading volume before options listing. The trading volume ratio is calculated based on 270, 180, and 90 days windows.

Firm	Listing date	Trading volume ratio		
		270	180	90
ALUM	06/14/04	0.9113	0.9824	1.1742
BEAA	01/08/01	0.8303	0.9420	1.0152
BOC	03/17/03	-	-	1.4525
CATH	08/27/01	1.2062	1.2001	1.2040
CCEC	09/03/07	-	-	1.0113
CHGK	09/25/95	0.8606	0.9170	1.1378
CHPE	07/22/02	0.8177	0.8313	0.7343
CHRL	06/10/08	-	-	0.6401
CHT	05/15/98	-	-	0.9394
CITP	10/23/95	1.1442	0.9742	1.1335
CKIH	08/27/01	1.2154	1.2203	1.3092
CLIG	12/18/95	1.4183	1.2250	1.2126
CLS	06/14/04	-	-	0.5182
CNOO	07/22/02	0.9160	0.9456	0.9887
CSHE	06/10/08	-	-	1.0999
CTC	06/14/04	0.6251	0.5538	0.5854
DENW	07/11/05	0.6028	0.8293	1.0776
ESPR	07/11/05	1.2426	1.1198	0.9705
FOXC	03/19/07	1.2277	1.2857	1.3690
FUNG	08/27/01	0.9599	1.2957	1.6051
HELD	12/18/95	1.4131	1.2272	1.0320
HKCG	08/27/01	0.9747	0.9979	0.9521
HKEL	02/16/98	1.0749	1.0983	0.7823
HKEX	08/27/01	-	0.7298	1.0195
HKWH	08/05/96	1.0064	0.9127	1.0465
HPI	07/22/02	1.0052	1.0493	0.9834
HSBA	12/09/96	1.9032	1.5442	1.1927
HSBC	09/08/95	0.9388	0.9424	1.0646
HUTI	12/18/95	1.1409	1.2022	1.5960
JCOP	09/03/07	0.9041	0.8243	0.9103
JNEL	08/27/01	0.9370	1.2135	1.6233
MTRC	08/27/01	-	0.5121	0.8333
NWDV	08/05/96	1.3016	1.2114	1.5849
PECH	08/27/01	0.5079	0.7648	0.8072
PICC	03/19/07	1.3335	1.4486	1.1392
PING	11/07/05	1.1974	1.4810	1.5838
SHKP	12/18/95	1.1785	1.2173	1.8413
SWPA	10/09/95	1.2732	1.2200	1.5406
TRIC	06/26/00	0.3705	0.3522	0.8864
UNIC	08/27/01	-	1.0502	1.1413
Mean ratio		1.0464	1.0389	1.1185
Median ratio		1.0064	1.0498	1.0711
SD		0.3022	0.2692	0.3066
N		31	34	40
Number of ratio > 1		17	18	26
p-value[a]		0.8334	0.9267	0.1202

[a] Refers to the Wilcoxon signed-rank test.

— data is not available for the entire period.

Table VII

Trading volume model, with option listing as dummy variable

Model Estimated: $\mathrm{Ln}(SV_{it}) = a_i + b_i D_t + \varepsilon_{it}$ where SV_{it} is trading volume standardized by number of share outstanding. D_t represents dummy variable which is one if the trading volume is in period after option is listed , and zero otherwise. ε_{it} is the random disturbance term for each stock. The model is estimated in 270, 180, and 90 days windows. Null hypothesis tested Ho: averaged $b_i = 0$.

Estimated	**Event window**					
Parameters	**270**		**180**		**90**	
Averaged a_i	-6.044207	***	-6.054581	***	-5.989901	***
	(-36.323)		(-39.131)		(-37.168)	
	[0.000]		[0.000]		[0.000]	
Averaged b_i	0.039041		0.018106		0.070595	
	(0.806)		(0.359)		(1.613)	
	[0.426]		[0.722]		[0.115]	

***, **,* indicates statistical difference from zero at 1,5,10 percent levels, respectively.
t-statistics presented in parentheses and *p*-value presented in brackets respectively.