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# Impact of Short Selling on Volatility of Individual Stocks and Aggregate Market: Empirical Evidence from China

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## Abstract

*This paper explored the linkage between short selling and market stabilization. While financial and economic theory advocates the positive role played by short sellers for market stabilization, short sellers are frequently blamed for causing market decline and increasing the panic in falling markets. China's regulators allowed short selling in 2010 and this reform provided us an interesting data set to check whether short sellers destabilize the market or play a positive role. By using asymmetric TGARCH model on daily return data of Shanghai Stock Exchange 50 index from January 5, 2007 to June 11, 2012, and taking into account Day-of-the-Week effect, financial crisis and regional and international spillovers, we found robust evidence that short sale trading reduces the volatility and stabilizes the market. Our findings have implications for China's regulators in policy making as well investors in the Chinese stock market in portfolio development.*

**Keywords**: Short Selling, Market stabilization, volatility, Stock Market Performance

## I. Introduction

Short selling was banned in many countries during the Global financial crisis (2007-2009) and European debt crisis (2009-2010). Regulators were of the view that short selling will destabilize the market through a further decline in the securities prices. Firm managers and media also speculated about the negative externalities of short selling. Chen and Singal (2003) argued that short selling can aid price manipulation. Short sellers can expand the supply of shares, thereby, creates a temporary depression in stock prices.

In this way short seller makes a profit from the failure of the market. Those who are more skeptical of financial markets emphasize that short selling (especially in its naked form) can artificially depress prices by expanding the supply of determining stocks (Safieddine and Wilhelm, 1996; Finnerty, 2005). Soros (2009), in his article in financial times states that short selling can have negative externalities on financial stability.

Despite of several studies which contended against short selling, economic theory and finance literature, mostly conclude that short selling plays a very important role in the accurate valuation of stocks. Economic theory suggests that if short selling is constrained, then negative information will not be incorporated in the market and it will manifest itself only once when the market is about to drop. The Rich amount of research evidences is available on positive aspects of short selling. Announcements about increase in short positions contain negative information about a stock which is then reflected in prices (Senchack and Straks, 1993). In a similar scenario, Asquith and Meul-Brooke (1996) proved the same relationship between short positions and subsequent stock returns by using the monthly data from the NYSE and ASE stocks.

Desai et al (2002) examines that heavily shorted firm on Nasdaq market exhibit significant negative abnormal returns even after controlling other factors. They concluded that short sellers play an important informational role. Boehmer et al (2008) contends that risk adjusted returns for heavily shorted stocks are lower than liquidly shorted stocks, suggesting that short sellers as a group are informed. This shows that short selling is adding to market efficiency by incorporating negative information into stocks. On the other hand short sellers put the stocks at peak time when prices are high and supply shares when markets are bullish, and purchase shares when markets are bearish thereby providing liquidity to the market (Woolridge and Dickinson 1994).

The impact of short selling on market volatility can be evaluated in two ways. One is to find impact of short selling bans on market volatility. There is a rich literature that exists in this domain. Miller (1977) claims that short selling restrictions tend to increase the magnitude of overpricing relative to fundamental values. Boehmer & Wu (2009) provide evidence that suggests that short selling bans are likely to create market distortions by hindering the ability of markets to engage in price discovery. Most recent work on evaluating the impact of short selling constraints is done by Bohl et al (2012) in Taiwan. By estimating several variants of an asymmetric GARCH model and a Markov switching GARCH model they found robust evidence that short selling restrictions raise stock return volatility.

There is a series of papers (e.g. Liao and Zhang (2005), Liao and Yang (2005a, 2005b), Wu and Liao (2007)) which investigate the causal relationship between market volatility and short sales in various stock markets. These papers were based on the co-integration and Granger causality tests, and the results suggest that short sales play an important role in buffering stock volatility instead of aggravating it. This aspect is still to be explored that after the short selling trade is allowed in the market how it changed the volatility of the market? We intended to explore this aspect by following the methodology of Bohl et al (2012). Stock market of China provides an interesting data set in this regard. During the short period of time this data set captured attention from researchers. Yang Deyong and Wu Qiong (2011) studied the impact of short selling on the Chinese market. Their research demonstrated the positive impact of short selling on market liquidity. Market volatility was also reduced to some extent due to short selling in the Chinese market. Chang E.C et al (2012), by using event study methodology, provided opposite results. According to them stock return volatility has been increased once stock has been allowed for the short selling. Wang X. and Wang F. (2012) studied the data set with the perspective of risk through VAR approach. Their results showed that Value at Risk (VAR) has decreased since the short selling mechanism has been launched.

We can see there is a contradiction in results in existing studies. This difference can be attributed to methodologies used in the analysis. Chang E. C et al (2012) used event study methodology. Problem in event study methodology is identified by Rigobon and Sack (2004) is that the event study approach is dependent upon a set of restrictive assumptions, namely that sample contains periods in which the innovations to the system are driven predominantly by the event shock. So, to get robust results in this methodology event shock should be infinitely large relative to the variances of other shocks in that time period. Also results by event study methodology can be interpreted for a short span of time. But we are interested to know the overall change in the market due to short selling in the long run. Taking into account the limitations of event study Bohl, M. T., et al. (2012) used TGARCH methodology arguing that due to short time duration of restrictions on short selling practices places limitations on the type of study that can be implemented to examine their consequences. Therefore the bulk of relevant literature relies on cross-sectional regressions, or resort to event type studies.

**A. Detail of Chinese Stock Market and DATA**

A Chinese stock market has developed rapidly since 1990s, when Shanghai Stock Exchange and Shenzhen Stock Exchange were established. Chinese stock markets topped the world in an initial public offering (IPO), and also overtook the Japanese market in terms of market capitalization, (LilaiXu, 2011).

**B. Developments in China Stock Market**

LilaiXu (2011) categorized the development of China's stock market into five phases. The first phase is from 1984-1990 when the economic system of china began to transform from a state planned into decentralized economy. Under this phase shares system was introduced in State Owned Enterprises (SOEs). From 1991-1996 when Shanghai Stock Exchange and Shenzhen Stock Exchange started electronic trading and during this phase IPO system was introduced. The third phase is 1997-1999 when the Chinese Government enforced strict regulations on the stock market to avoid from the contagion effect of the Asian financial crisis of the late 1990s. Phase four is when at the start of 1999 recession, banking sector of china was experiencing huge volume of Non-Performing Loans (NPLs) thus government implemented the policy which was motivated to expand the stock market to help maintain high GDP growth, which led to boosted IPOs and almost 90% of the SOEs were corporatized and hence Shanghai Composite Index boosted up from a low of 1043 on 19 May 1999 to a record high of 2240 on 13 June 2001. Phase five is during 2002-2005 when institutional investors emerged as important players in the market and during this period government holdings were reduced substantially. Recent developments in Chinese market include Nasdaq-style second board Chi Next on 23 October 2009. Stock index futures were also launched on 16 April 2010.

**C. Market Performance**

Branstetter (2007) provided evidence after a historical analysis that China's market performed poorly during 2003 and 2004. But during the 2006 market performed well and at the end of 2006 Shanghai Composite Index, which is the biggest market of China closed at 2675 while 6093 on 16 October 2007. According to Li (2007), total 120 IPOs worth 409.7 billion yuan collection were made in 2007, highest in the world in term of amount raised.

**D. Market downturn**

In October 2008, Chinese stock market had hit by a downturn when it dropped by 71% from its peak in October 2007, P/E ratio declined from 69 in October 2007 to 20 in October 2008. Also trading volume of Shanghai Stock Exchange as well as Shenzhen Stock Exchange declined. But market regained with successive IPOs during 2008 (103.4 billion Yuan) and 2009 (183.1 billion Yuan) and in the first quarter of 2010 another 118.9 billion Yuan worth of IPOs were launched. (LilaiXu 2011)

**E. Introduction of Short Selling in Chinese Market**

Short selling was prohibited in Chinese Stock Markets before March 31, 2010. China regulators were reluctant to allow short selling due to threat that short selling will cause downturn and distortions in the market. On March 30, 2010, the China Security Regulation Committee (CSRC) formally allowed the short sale trading. CSRC allowed test run in 90 selected stocks in Shanghai Stock Exchange and Shenzhen Stock Exchange. This reform provides a unique data set for studying the impact of short selling on market volatility.

There are different categories of indices in Shanghai Stock Exchange. Major categories are SSE Constituent Indices, SSE Composite Indices, SSE Sector Indices, SSE Style Indices, SSE Thematic Indices, SSE Fund Indices, SSE Bond Indices and Other Indices category. All major categories are further categorized into sub-categories which give an investor a greater number of available options for portfolio development. SSE Constituent Indices include two types of indices, 180 indices consisting of 180 largest market capitalization stocks and second is 50 index. SSE 50 Index selects 50 largest stocks of good liquidity and representatives from the Shanghai security market by scientific and objective method. We selected SSE 50 index for our analysis because almost 80% of the index market capitalization is captured by the firms in which short selling is allowed.

Therefore, our empirical analysis relies on SSE 50 index and 25 top market capitalization value stocks which were allowed for the short selling. We measured regional and international influence on China's market with a S&P index of USA, Taiwan Weighted Index (TWII), and Hang Seng Index (HIS) Hong Kong. Data source for the indices is Yahoo finance. All the stock indices are available on a daily frequency with a closing price of every day as is used by Bohl et al (2012) in their study, from January 5, 2007 to June 11, 2012. All indices have specially been converted to US dollar for nullifying the currency effect. The daily exchange rate of Chinese Yuan (CNY), Taiwan Dollar (TWD), and Hong Kong Dollar (HKD) are taken from http://www.oanda.com.

## II. Methodology

Our purpose is to model returns of the Shanghai Stock Exchange 50 Index (SSE 50) and 25 companies which were allowed for the short selling on 31st march using conditional volatility models. These 25 companies are having maximum market capitalization and listed on Shanghai Stock Exchange. Exponential GARCH (EGARCH) and threshold GARCH (TGARCH) are the most widely used asymmetric conditional volatility models. The results given in this paper are from TGARCH model as both the models produced virtually same results and additional diagnostic testing did not allow us to choose one on the other. Our empirical investigation of the effect of short sale trading on stock market volatility is based on following TGARCH model:

$$r_t^{sse} = \alpha_0 + \sum_{i=1}^{4} \alpha_i \, DoW_{it} + \alpha_5 r_{t-1}^{sse} + \beta_1 r_{t-1}^{us} + \beta_2 r_t^{tai} + \beta_3 r_t^{hk} + \beta_4 fc_t + \varepsilon_t \quad (1)$$

$$h_t = \omega + \gamma_1 \varepsilon_{t-1}^2 + \gamma_2 h_{t-1} + \gamma_3 I_t \varepsilon_{t-1}^2 + \gamma_4 D_t I_t \varepsilon_{t-1}^2 + \sum_{i=1}^{p} \theta_i \, \varepsilon_{t-1}^2 \quad (2)$$

$$r_t^c = \varphi_0 + \sum_{i=1}^{4} \varphi_i \, DoW_{it} + \varphi_5 r_{t-1}^c + \delta_1 r_t^{sse} + \varepsilon_t \quad (3)$$

$$h_t = \phi + \psi_1 \varepsilon_{t-1}^2 + \psi_2 h_{t-1} + \psi_3 I_t \varepsilon_{t-1}^2 + \psi_4 D_t I_t \varepsilon_{t-1}^2 + \tau_1 \varepsilon_{t-1}^{sse\wedge 2} \quad (4)$$

$$I_t = \begin{cases} 1 \;\; if \; \varepsilon_{t-1} < 0 \\ 0 \; if \; \varepsilon_{t-1} \geq 0 \end{cases} \quad (5)$$

$$D_t = \begin{cases} 1 \;\; March\ 31st, 2010\ to\ end\ of\ sample \\ \quad 0\ 1st\ Jan\ 2007\ to\ March\ 30, 2010 \end{cases} \quad (6)$$

$$fc_t = \begin{cases} 1 \;\; after\ August\ 9, 2007 \\ 0\ before\ August\ 9, 2007 \end{cases} \quad (7)$$

Equation (1) and (2) is mean and variance equation for SSE 50 index respectively. Index returns are defined as 100 times the logarithm difference $r_t = ln\,P_t - ln\,P_{t-1}$and $\varepsilon_t = N(0, h_t)$ Is an unpredictable component of the stock index returns. $\sum_{i=1}^{4} \alpha_i\, DoW_{it}$is the day of the week dummy with value 1 for Tuesday, Wednesday, Thursday and Friday $i = 1, \ldots, 4$. $r_{t-1}^{sse}$is lagged term of the SSE index which enables us to detect autocorrelation in the data. Stock returns of S&P 500$r_{t-1}^{us}$, Taiwan Weighted Index$r_t^{tai}$ and Heng Seng Index$r_t^{hk}$ are used to check whether there is a spillover effect on the returns from these markets. Notice that US returns are lagged but others are contemporaneously[1] related to the dependent variable since stock markets in Taiwan and Hong Kong trade in the same time zone, while the U.S. market is lagged as New York is 12 hours behind. In the conditional variance equation squared residual terms of every index are lagged as volatility realized is known only at the end of the day.

Equation (3) and (4) are mean and the variance equation which has been tested for every company. No spillover from international markets has been included in the

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[1]We also estimated return spillover effects of Taiwan and Hong Kong indexes with lags but lagged return spillovers turned to be insignificant which indicated that return spillovers are contemporaneous as modeled by Bohl M.T et al (2012).

equation as international spillover will be incorporated through its impact on overall market, which will be captured by spillover by SSE 50 index.$I_t$takes value of 1 if return innovation is negative and 0 if its equal to zero or positive. $fc_t$ dummy is to capture the effect of Global financial crisis and it takes value 0 before 9th August 2007 and 1 after 9th August 2007 when there is the seizure in the banking system precipitated by BNP Paribas announcing that it was ceasing activity in three hedge funds that specialized in US mortgage debt and this triggered the financial crisis. Still no official announcement is being made for the end of the financial crisis.

Volatility equation is a version of asymmetric GARCH model which is forwarded by Glosten et al (1993) which is modeled to check the different effect of negative and positive innovation on volatility by use of a dummy variable $I_t$. In case if this dummy turns out to be significant and positive it will imply that negative shock has greater effect as compare to positive shock of same magnitude. Most important coefficient for our research is $\gamma_4$ in equation (2) and$\psi_4$in equation (4). If $\gamma_4, \psi_4$<0 and significant then we can conclude that short selling has a dampening influence on the volatility during falling markets and in presence of short selling negative news has less impact as compare to its impact when short selling was not allowed. If $\gamma_4, \psi_4$= 0 it means there is no effect of short selling on market volatility and if $\gamma_4, \psi_4$>0 then short selling increase the market volatility during falling markets.

With the dummy variable $D_t$ regulatory change is modeled. This dummy takes value of 1 after 31$^{st}$ March 2010 till the end of the sample in which short sale trading is allowed and takes value of 0 from start of the sample till 30th March 2010 when short sale trading was prohibited. To check the volatility transmission from regional and international market $\sum_{i=1}^{p} \theta_i \, \varepsilon_{t-1}^2$ are the lagged squared error terms of U.S., Taiwan and Hong Kong indices are used as are used by Hamid. R., (1994) in their work on volatility transmission in Atlantic and Pacific stock markets.

## III. Empirical Results

Table 1 shows the descriptive statistics describing distributional properties of SSE 50 index returns. The index returns are mildly skewed. However the excess kurtosis of all the index returns confirms that distributions of the returns are leptokurtic in nature. Meanwhile null hypothesis of normal distribution is rejected for all the index returns at 1% level of significance.

**Table 1: Descriptive Statistics**

| Statistic | China | Taiwan | USA | Hong Kong |
|---|---|---|---|---|
| **Mean** | -7.24E-05 | -0.000197 | -0.000356 | -0.000178 |
| **Median** | 0.000717 | 0.001081 | 0.000673 | 6.98E-05 |
| **Maximum** | 0.093295 | 0.069208 | 0.109572 | 0.134068 |
| **Minimum** | -0.09917 | -0.069342 | -0.094695 | -0.135511 |
| **Std. Dev.** | 0.021348 | 0.016126 | 0.016119 | 0.019453 |
| **Skewness** | -0.2671 | -0.263928 | -0.111754 | 0.039862 |
| **Kurtosis** | 5.208890 | 4.908446 | 9.822201 | 9.649852 |
| **Jarque-Bera** | 253.9241 | 192.7725 | 2290.792 | 2174.489 |
| **Probability** | 0.000000 | 0.000000 | 0.000000 | 0.000000 |

| | | | | |
|---|---|---|---|---|
| **Sum** | -0.08547 | -0.232199 | -0.419715 | -0.209828 |
| **Sum Sq. Dev.** | 0.537295 | 0.306595 | 0.306329 | 0.446156 |

**Table 2: Correlation Matrix**

| | **China** | **Taiwan** | **USA** | **Hong Kong** |
|---|---|---|---|---|
| **China** | 1.000000 | | | |
| **Taiwan** | 0.328856 | 1.000000 | | |
| **USA** | 0.072588 | 0.139406 | 1.000000 | |
| **Hong Kong** | 0.518496 | 0.591714 | 0.275731 | 1.000000 |

Table 2 gives the correlations among the regional and international markets. Correlation coefficients in case of regional markets are greater than international market. Hong Kong market is strongly correlated with the other two markets in the region. Hsieh (1989) shows that although the spot foreign exchange markets are not highly auto correlated, but they are strongly heteroscedastic. Results shown in Table 3A tells same story in stock markets. For the Raw Returns, the Box-Pierce Q statistics shows that, exception to US market, all the other markets shown very low or insignificant autocorrelation in general up to 24 lags. When Box-Pierce Q test is applied to squared returns all the markets showed highly significant autocorrelation, as reported in Table 3B. This indicates that a strong conditional heteroscedasticity presents in the data and leads us to a conclusion that AR (1) process in conjunction with GARCH model would results in parsimonious model for this data [see, e.g., Bollerslev (1986)].

**Table 3: box-Pierce Q test Results**

| **Q-Statistics** | **SSE** | **US** | **TAI** | **HK** |
|---|---|---|---|---|
| **A. Q Test for Autocorrelation of Raw Returns** | | | | |
| **Lag(6)** | 6.2144 | 20.631*** | 8.3876 | 3.7195 |
| **Lag(12)** | 10.175 | 34.157*** | 20.218* | 23.5** |
| **Lag(18)** | 11.419 | 54.443*** | 26.156* | 28.939** |
| **Lag(24)** | 15.481 | 72.81*** | 37.145** | 30.416 |
| **B. Q Test for Autocorrelation of Squared Returns** | | | | |
| **Lag(6)** | 90.794*** | 501.53*** | 89.734*** | 431.47*** |
| **Lag(12)** | 170.96*** | 988*** | 203.19*** | 756.33*** |
| **Lag(18)** | 227.78*** | 1239.4*** | 297.08*** | 835.59*** |
| **Lag(24)** | 323.04*** | 1444.5*** | 342.04*** | 953.48*** |

*,**,and *** shows significance at 10%, 5% and 1% level of significance.

Parameter estimates of both mean and variance equation are summarized in Table 4 for equation (1) and (2), while parameter estimates for equation (3) and (4) for all the companies are given in table 5. Analyzing coefficients estimates of mean equation we can see Day-of-the-Week dummies are negatively significant for Tuesday, Wednesday and Thursday while insignificant for Friday. This result is consistent with the previous literature on China's stock markets. Bohl *et al* (2010) provided evidence by using data of China's stock exchanges from 1994 to 2007 for Day-of-the-Week effect, more pronounced for Tuesday (significantly negative). They attributed this Day-of-the-Week effect to foreign institutional investor trading and this conclusion is consistent with previous US evidence showing that stocks with high institutional ownership exhibit stronger daily seasonality (Sias & Starks, 1995). One argument made by Bohl *et al* (2010) is that one of the possible reasons for this effect in China's market can be an official ban on short selling. As if there is negative Day-of-the-Week effect and short trading is allowed, rational arbitrageurs could short the stock in the morning at that day and then cover their position in next day. But our findings are not in favor of this argument as negative day of the week effect still persist in the market even short selling is allowed. Also negative Tuesday effect is consistent with evidences for Asian markets (Agrawal &Tandon, 1994;Jaffe &Westerfield, 1985).

**Table 4: TGARCH Result**

| Mean Equation | | Variance Equation | |
|---|---|---|---|
| **Coefficient** | $r_t^{sse}$ | **Coefficient** | $h_t$ |
| $\alpha_0$ | 0.005729*** (0.0080) | $\omega$ | 0.00000917*** (0.0001) |
| $\alpha_1$ | -0.003767*** (0.0050) | $\gamma_1$ | 0.034181*** (0.0159) |
| $\alpha_2$ | -0.002116* (0.0938) | $\gamma_2$ | 0.899923*** (0.0000) |
| $\alpha_3$ | -0.002730** (0.0383) | $\gamma_3$ | 0.076449*** (0.0003) |
| $\alpha_4$ | 0.000712 (0.5969) | $\gamma_4$ | -0.095100*** (0.0001) |
| $\alpha_5$ | 0.031405 (0.2337) | $\theta_{us}$ | 0.006558 (0.2183) |
| $\beta_1$ | -0.069946** (0.0401) | $\theta_{tai}$ | -0.009225 (0.1927) |
| $\beta_2$ | 0.066994** (0.0450) | $\theta_{hk}$ | 0.007285 (0.1842) |
| $\beta_3$ | 0.567842*** (0.0000) | | |
| $\beta_4$ | -0.004375** (0.0318) | **Log Likelihood** | 3193.982 |

Note: values in parenthesis are probabilities. *,**,and *** shows significance at 10%, 5% and 1% level of significance.

Coefficients for regional and global spillover effects in returns also turns to be significant but magnitude of the spillover effect from regional and international markets differs. Hong Kong market has largest coefficient value and so the magnitude of it effect on china is greater than Taiwan and U.S. While magnitude of the effect of U.S. market is almost the same with Taiwan but in negative direction. Again these results are consistent with previous literature in Chinese stock markets. Bohl et al (2010) provided evidence of significantly negative spillover from USA, and significantly positive from Taiwan and Hong Kong. Chen et al. (2001) also provided with the same evidences.

Coefficient estimate $\beta_4$ is statistically significant at 5% level of significance. This is negative effect of global financial crisis on China's stock market. But magnitude of the effect is not that much bigger. As discussed in the section on China market, during global financial crisis China's market performed very well and successive IPO's were launched collecting 103.4 billion Yuan in 2008, 183.1 billion Yuan in 2009 and 118.9 billion Yuan during 1st quarter of 2010, (LilaiXu, 2011). Also, Shanghai stock Index increased around 80% per annum at the end of 2009, (G. N. Gregoriou, 2012).And finally$\alpha_5$ is not significant so there is no autocorrelation in the returns. Now analyzing results of mean equation (3) in table 5 we can see the positive effect of SSE 50 index of all the companies. Results of day of the week effect are not given for preciseness. No company showed any significant day of the week.

Turning to estimation results of variance equation, the significant positive coefficient of $\gamma_1$Suggest that unexpected stock returns ($\varepsilon_{t-1}^2$) increase the volatility in the market. Moreover, significant positive estimate of coefficient $\gamma_2$tells us that volatility in the China market is highly persistent. The evidence of asymmetry is significant. As $\gamma_3$is significantly positive, so we can conclude that negative innovation in the market has greater impact in comparison to positive innovation of the same magnitude. Previous literature on seasonality effect is mixed for Chinese markets. Yin-Hua & T.S. Lee, (2000), by using data of Greater China stock markets during the period of 1992 to 1996 provided with evidence that there is asymmetry in Taiwan and Hong Kong market, but this is not significant in the case of Chinese markets and they attributed this to good-news-chasing behavior of investors in China. While Bohl et al (2010), after using more recent data of Shanghai and Shenzhen markets provided the evidence for information asymmetry in both the markets. This change can be attributed to financial liberalization in China after 2001. As foreign individual and institutional investors enter into the market and this good news chasing behavior disappears. Spillover effects of all the regional, i.e., Taiwan ($\theta_{tai}$) and Hong Kong ($\theta_{hk}$) as well as international markets, i.e. USA ($\theta_{us}$) in variance equations remained insignificant. Turning to the empirical findings on effect of short trading on volatility, which is our main interest here, we can significantly conclude that the short selling reduced the volatility in the market as $\gamma_4$is statistically significant and negative at 1% level of significance.

Analyzing results of variance equation (4) given in table 5 and summarized in table 6, we can see that out of 25 companies 20 showed significant negative results with the mean coefficient value of -0.23879 while three companies with a mean coefficient value of -0.01576 remained negative and insignificant. Only two companies out of our sample showed positive effect, but result remained insignificant with mean coefficient value of 0.04584. Out of 25 stocks 4 showed a negative spillover effect from SSE 50 index. 17 stocks showed significant positive spillover while another remained insignificant. It shows the resilience of the few stocks against the market volatility. Two important points are worthy to be mentioned here. First short selling was allowed in China during the time period of global financial crisis when markets all over the world were under downward pressure. It is generally argued that short sellers depress the market further during bearish times, but as is evident this argument is significantly proven false at least in the Chinese market. Secondly purpose of using TGARCH model was to check the impact of the short selling on volatility during falling markets (TGARCH term is multiplied with short selling dummy " $D_t I_t \varepsilon_{t-1}^2$") so once again this is evident that during falling markets short selling decreases the market volatility and play its part in stabilizing the market.

## Table 5(a): TGARCH results of equation (3) and (4)

| Code | Company name | Mean Equation | | | Variance Equation | | | | | Diagnostics | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $\varphi_0$ | $\varphi_5$ | $\delta_1$ | $\psi_1$ | $\psi_2$ | $\psi_3$ | $\psi_4$ | $\psi_5$ | Log Lik | R2 |
| 601111 | China Airline | -0.00116 | 0.09578*** | 1.17094*** | 0.06831*** | -0.02600 | 0.92427*** | -0.06108*** | 0.00649 | 2574.6 | 0.47 |
| | | | (0.00001) | (0.00000) | (0.00000) | (0.17002) | (0.00000) | (0.00070) | (0.41254) | | |
| 601600 | Aluminum Corporation of China | -0.00654 | 0.04139 | 1.05749*** | 0.09330** | -0.08942** | 0.52320*** | -0.19534*** | -0.05340*** | 2496.0 | 0.45 |
| | | | (0.13000) | (0.00000) | (0.01890) | (0.05480) | (0.00020) | (0.00000) | (0.00670) | | |
| 601988 | Bank of China | -0.00079 | -0.06886*** | 0.68428*** | 0.33446*** | 0.05418 | 0.68649*** | -0.33188*** | 0.00683* | 3521.5 | 0.63 |
| | | | (0.00020) | (0.00000) | (0.00000) | (0.27370) | (0.00000) | (0.00000) | (0.08530) | | |
| 601328 | Bank of Communication | -0.00175 | -0.02465 | 0.95239*** | 0.06106*** | 0.01767 | 0.88204*** | -0.08763*** | 0.00255 | 3112.2 | 0.71 |
| | | | (0.18120) | (0.00000) | (0.00190) | (0.42350) | (0.00000) | (0.00000) | (0.34090) | | |
| 601328 | Baoshan Iron & Steel | -0.00076 | 0.06535*** | 0.92874*** | 0.14204*** | 0.05577 | 0.78715*** | -0.23224*** | 0.02773*** | 3066.0 | 0.61 |
| | | | (0.00040) | (0.00000) | (0.00000) | (0.20720) | (0.00000) | (0.00000) | (0.00020) | | |
| 601898 | China Coal | 0.00098 | 0.01512 | 1.10934*** | 0.05590*** | 0.10482*** | 0.87211*** | -0.17627*** | -0.01437*** | 2923.2 | 0.65 |
| | | | (0.20900) | (0.00000) | (0.00070) | (0.00930) | (0.00000) | (0.00020) | (0.00330) | | |
| 600030 | Citic Securites | 0.00137 | -0.02166 | 1.36293*** | 1.98956*** | -1.65827*** | 0.07987*** | -0.03340 | 1.15701*** | 2498.9 | 0.35 |
| | | | (0.42980) | (0.00000) | (0.00000) | (0.00000) | (0.00000) | (0.80440) | (0.00000) | | |
| 601939 | China Construction Bank | -0.00128 | -0.05080*** | 0.74309*** | 0.26838*** | -0.01677 | 0.68117*** | -0.22391*** | 0.01491*** | 3109.8 | 0.70 |
| | | | (0.00470) | (0.00000) | (0.00000) | (0.75360) | (0.00000) | (0.00000) | (0.00250) | | |
| 601006 | Daqin Railway | 0.00165 | 0.02421 | 0.85682*** | 0.17889*** | 0.08428 | 0.50335*** | -0.34791*** | 0.06103*** | 2913.9 | 0.48 |
| | | | (0.30040) | (0.00000) | (0.00000) | (0.19360) | (0.00000) | (0.00000) | (0.00000) | | |
| 601398 | ICBC | 0.00051 | -0.03016* | 0.71069*** | 0.32382*** | -0.02398 | 0.65249*** | -0.30537*** | 0.01753*** | 3454.7 | 0.60 |
| | | | (0.07270) | (0.00000) | (0.00000) | (0.57180) | (0.00000) | (0.00000) | (0.00070) | | |
| 601628 | China Life | -0.00201 | -0.01614 | 1.07315*** | 0.08506*** | -0.02469 | 0.90423*** | -0.05378*** | 0.01281*** | 3205.9 | 0.69 |
| | | | (0.31790) | (0.00000) | (0.00000) | (0.23650) | (0.00000) | (0.00470) | (0.00010) | | |
| 600036 | China Merchants Bank | -0.00115 | -0.01362 | 1.07734*** | 0.17242*** | 0.11001** | 0.72763*** | -0.29596*** | 0.01863*** | 3313.8 | 0.73 |
| | | | (0.32080) | (0.00000) | (0.00000) | (0.05530) | (0.00000) | (0.00000) | (0.00130) | | |
| 600016 | Mingsheng Bank | -0.00238 | -0.10363*** | 1.00151*** | 0.36663*** | -0.35513*** | 0.74126*** | -0.01282*** | 0.02190*** | 3098.6 | 0.62 |
| | | | (0.00000) | (0.00000) | (0.00000) | (0.00000) | (0.00000) | (0.11320) | (0.00160) | | |
| 601601 | China Pacific Insurance Company | -0.00086 | -0.01934 | 1.22011*** | 0.08138*** | -0.00994 | 0.88145*** | -0.04801** | 0.01361*** | 2556.8 | 0.72 |
| | | | (0.30510) | (0.00000) | (0.00000) | (0.68580) | (0.00000) | (0.01750) | (0.00100) | | |
| 601857 | PetroChina | -0.00207 | 0.06643*** | 0.91434*** | 0.09918*** | 0.01389 | 0.87497*** | -0.09189*** | 0.01265*** | 3108.2 | 0.58 |
| | | | (0.00100) | (0.00000) | (0.00000) | (0.67720) | (0.00000) | (0.00050) | (0.01060) | | |

## Table 5(b): TGARCH results of equation (3) and (4)

| Code | Company name | Mean Equation | | | Variance Equation | | | | | Diagnostics | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $\varphi_0$ | $\varphi_5$ | $\delta_1$ | $\psi_1$ | $\psi_2$ | $\psi_3$ | $\psi_4$ | $\psi_5$ | Log Lik | R2 |
| 601318 | China Pingan | -0.00060 | 0.00509 | 1.14970*** | 0.04293*** | 0.07784** | 0.83465*** | -0.13544*** | 0.02010*** | 2954.7 | 0.68 |
| | | | (0.76540) | (0.00000) | (0.00170) | (0.01830) | (0.00000) | (0.00000) | (0.00000) | | |
| 600104 | SAIC Motor | 0.00078 | 0.04471** | 1.04653*** | 0.07267** | 0.00631 | -0.06446 | 0.07824 | -0.06661*** | 2475.9 | 0.45 |
| | | | (0.06740) | (0.00000) | (0.01960) | (0.90430) | (0.56240) | (0.47660) | (0.00000) | | |
| 601727 | Shanghai Electric Group | 0.00272 | 0.03412 | 1.03170*** | 0.12225 | 0.25890 | 0.54828*** | -1.72293*** | 0.05773 | 1651.8 | 0.04 |
| | | | (0.83590) | (0.00000) | (0.62760) | (0.42510) | (0.00000) | (0.00440) | (0.85140) | | |
| 601088 | China Shenhua | 0.00045 | 0.04638** | 1.13585*** | 0.15785*** | 0.04773 | 0.79066*** | -0.08386* | 0.01618** | 2680.7 | 0.63 |
| | | | (0.01230) | (0.00000) | (0.00000) | (0.37820) | (0.00000) | (0.08520) | (0.01660) | | |
| 600000 | SPD Bank | 0.00237 | -0.01592 | 1.00601*** | 0.21524*** | -0.22197*** | 0.76123*** | -0.00106 | -0.00747 | 2599.5 | 0.46 |
| | | | (0.62880) | (0.00000) | (0.00000) | (0.00000) | (0.00000) | (0.80120) | (0.64640) | | |
| 600050 | China Union | -0.00121 | 0.02192 | 0.90125*** | 0.11565*** | -0.01229 | 0.81323*** | -0.09556*** | 0.04718*** | 2907.1 | 0.53 |
| | | | (0.33010) | (0.00000) | (0.00000) | (0.69570) | (0.00000) | (0.00980) | (0.00000) | | |
| 600900 | China Yangtze Power | 0.00120 | -0.01220 | 0.73898*** | 0.05548 | -0.02369 | 0.54647** | -0.03660*** | -0.07869*** | 2066.6 | 0.28 |
| | | | (0.80370) | (0.00000) | (0.38090) | (0.70980) | (0.05810) | (0.00010) | (0.00000) | | |
| 601899 | Zijin Mining | -0.00158 | 0.05887*** | 1.19174*** | 0.18920*** | 0.05992*** | 0.71064*** | -0.11341** | 0.08495*** | 2552.1 | 0.54 |
| | | | (0.15260) | (0.00640) | (0.00000) | (0.00000) | (0.30500) | (0.00000) | (0.00000) | | |
| 600519 | Kweichow Moutai | 0.00124 | 0.05742** | 0.51097*** | 0.15324*** | 0.00219 | 0.69453*** | -0.1365*** | 0.05830*** | 2846.6 | 0.24 |
| | | | (0.03940) | (0.00000) | (0.00000) | (0.96260) | (0.00000) | (0.00310) | (0.00030) | | |
| 601390 | China Railway Group | -0.00093 | 0.03584 | 0.79025*** | 0.12941*** | -0.00753 | 0.74451*** | 0.01344 | 0.06540*** | 2535.14 | 0.56 |
| | | | (0.18000) | (0.00000) | (0.00000) | (0.85980) | (0.00000) | (0.73050) | (0.00000) | | |

## Table 6: Summarized results of Short Selling

| Effect of short selling | | Average Coefficient | No. of Stocks |
|---|---|---|---|
| Negative effect on volatility | Significant | -0.23879 | 20 |
| | Insignificant | -0.01576 | 3 |
| Positive effect on volatility | Significant | - | - |
| | Insignificant | 0.04584 | 2 |

## IV. Conclusions

This paper contributes to the debate on effect of short selling on volatility of the stock market. Our empirical results show that when the market falls, short selling has a counter effect on volatility. Our analysis also shows that investors' response to information is also changing. Previous research on the Chinese market by Yeh and Lee (2000) showed good news seeking behavior of investors in China, but as China stock markets now open to international investors, information asymmetry exists in the market. Furthermore, global financial crisis has a negative effect on the Chinese market, but this effect is not very large as far as its magnitude is concerned. Chinese markets are being affected by regional markets positively but negatively by the international markets. Argument by Bohl. M. T. et al (2010) that Day-of-the-Week analogy can be attributed to absence of short selling is also nullified by our results as this analogy still persists in the market. Our findings validate reforms of Chinese regulators to allow short selling. It played a positive role in stabilizing the market even during the time of global financial crisis. Furthermore, investors find it beneficial as they can build their portfolios after considering the dampening effect of short selling on their risk. Further research can be conducted on China's unique data set to check the causality relationship between short selling and volatility. A study can be conducted to know the effect of companies' performance on short selling. Effect of short selling on intraday volatility in the

## References

Agrawal, A., & Tandon, K. (1994). Anomalies or illusions? Evidence from stock markets in eighteen countries. *Journal of international Money and Finance*, *13*(1), 83-106.

Asquith, P., & Meulbroek, L. K. (1995). *An empirical investigation of short interest*. Division of Research, Harvard Business School.

Boehmer, E., & Wu, J. (2009). Short selling and the informational efficiency of prices. *Unpublished manuscript*.

Boehmer, E., Jones, C. M., & Zhang, X. (2008). Which shorts are informed?. *The Journal of Finance*, *63*(2), 491-527.

Bohl, M. T., Schuppli, M., & Siklos, P. L. (2010). Stock return seasonalities and investor structure: Evidence from China's B-share markets. *China Economic Review*, *21*(1), 190-201.

Bohl, M. T., Essid, B., & Siklos, P. L. (2012). Do short selling restrictions destabilize stock markets? Lessons from Taiwan. *The Quarterly Review of Economics and Finance*, *52*(2), 198-206.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of econometrics*, *31*(3), 307-327.

Bris, A., Goetzmann, W. N., & Zhu, N. (2007). Efficiency and the bear: Short sales and markets around the world. *The Journal of Finance*, *62*(3), 1029-1079.

Chen, G., Kwok, C. C., & Rui, O. M. (2001). The day-of-the-week regularity in the stock markets of China. *Journal of Multinational Financial Management*, *11*(2), 139-163.

Chen, H., & Singal, V. (2003). Role of speculative short sales in price formation: The case of the weekend effect. *The Journal of Finance*, *58*(2), 685-706.

Desai, H., Ramesh, K., Thiagarajan, S. R., & Balachandran, B. V. (2002). An investigation of the informational role of short interest in the Nasdaq market. *The Journal of Finance*, *57*(5), 2263-2287.

Feroz, E. H., Kim, S., & Raab, R. L. (2003). Financial statement analysis: A data envelopment analysis approach. *Journal of the operational Research Society*, *54*(1), 48-58.

Chang, E. C., Luo, Y., & Ren, J. (2012). Costly and unprofitable speculation: evidence from trend-chasing Chinese short-sellers and margin-traders. *Social Science Research Network*.

Finnerty, J. D. (2005). Short selling, death spiral convertibles, and the profitability of stock manipulation. *Death Spiral Convertibles, and the Profitability of Stock Manipulation (March 2005)*.

Finnerty, J. D. (2005). Short selling, death spiral convertibles, and the profitability of stock manipulation. *Death Spiral Convertibles, and the Profitability of Stock Manipulation (March 2005)*.

Gregoriou, G. N. (2011). *Handbook of short selling*. Academic Press.

Glosten, L. R., Jagannathan, R., & Runkle, D. E. (1993). On the relation between the expected value and the volatility of the nominal excess return on stocks. *The journal of finance*, *48*(5), 1779-1801.

Rahman, H., & Yung, K. (1994). Atlantic and Pacific stock markets—correlation and volatility transmission. *Global Finance Journal*, *5*(1), 103-119.

Hsieh, D. A. (1989). Testing for nonlinear dependence in daily foreign exchange rates. *Journal of Business*, 339-368.

Harju, K., & Hussain, S. M. (2011). Intraday seasonalities and macroeconomic news announcements. *European Financial Management*, *17*(2), 367-390.

Jaffe, J., & Westerfield, R. (1985). The week‐ end effect in common stock returns: The international evidence. *The journal of finance*, *40*(2), 433-454.

Karpoff, J. M., & Lou, X. (2010). Short sellers and financial misconduct. *The Journal of Finance*, *65*(5), 1879-1913.

Liao, Shing-guang, and Chao-jun Yang, (2005), A study on the relationship between the short selling and stock price in the securities market: evidence from Taiwan stock market, Journal of Financial Research 10, 131-140.

Liao, S. G., & Yang, C. J. (2005). The short selling mechanism, the market fluctuation, and the market fluidity. *Management World*, *12*, 6-13.

Liao, S. G., & Zhang, Z. X. (2005). The shock effect of short selling mechanism to emerging market: Evidence from Hong Kong stock market. *Journal of Finance and Economics*, *10*, 42-52.

Xu, L., & Oh, K. B. (2011). The stock market in China: An endogenous adjustment process responding to the demands of economic reform and growth. *Journal of Asian Economics*, *22*(1), 36-47.

Miller, E., Risk, Uncertainty and Divergence of Options, (1977), *Journal of Finance* 32

Safieddine, A., & Wilhelm, W. J. (1996). An empirical investigation of short- selling activity prior to seasoned equity offerings. *The Journal of Finance*, *51*(2), 729-749.

Senchack, A. J., & Starks, L. T. (1993). Short-sale restrictions and market reaction to short-interest announcements. *Journal of Financial and quantitative analysis*, *28*(02), 177-194.

Soros, G. (2009). The game changer. *Financial Times*, *28*.

Thore, S., Kozmetsky, G., & Phillips, F. (1994). DEA of financial statements data: the US computer industry. *Journal of Productivity Analysis*, *5*(3), 229-248.

Lin, W. C., Liu, C. F., & Chu, C. W. (2005). Performance efficiency evaluation of the Taiwan's shipping industry: an application of data envelopment analysis. In *Proceedings of the Eastern Asia Society for Transportation Studies* (Vol. 5, pp. 467-476).

Woolridge, J. R., & Dickinson, A. (1994). Short selling and common stock prices. *Financial Analysts Journal*, *50*(1), 20-28.

Wang, X., & Wang, F. (2012, June). Short selling mechanism, market risk reduced: Evidence from a share market of China. In *Robotics and Applications (ISRA), 2012 IEEE Symposium on* (pp. 13-15). IEEE.

Deyong, Y., & Qiong, W. (2011, May). The impact of margin trading on the liquidity and volatility of the securities market based on the empirical research of the Shanghai security market. In *Business Management and Electronic Information (BMEI), 2011 International Conference on* (Vol. 1, pp. 415-419). IEEE.

Yeh, Y. H., & Lee, T. S. (2001). The interaction and volatility asymmetry of unexpected returns in the greater China stock markets. *Global Finance Journal*, *11*(1), 129-149.

Yusuf, G., & Hakan, C. (2011). Date Envelopment Analysis: An augmented method for the analysis of firm performance. *International Research Journal of finance and Economics*, *79*.