

How do Investors in the Korean Stock Market React to Nuclear Threats from North Korea?

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Abstract

This article examines how investors react to nuclear threats from North Korea on the South Korean stock market. To investigate the differences in investor groups' responses, we divide investors into three groups: domestic individual, domestic institution and foreign investors. In addition, we classify the nuclear threats into the one actual threat and the seven verbal threats and compare trading activities of investors against those in the peaceful period of 2004. The net-buying and LSV(1992) herding measures are applied to examine investors' trading behavior. Our results show that it was only for the case of the actual threat that investors' trades significantly differed with the peaceful period. In addition, our results show that the three investor groups reacted to the actual nuclear threat differently. When the actual nuclear threat occurred, individuals sold, institutes and foreigners bought stocks. Like in the peaceful period, institutes showed a positive slope for lagged returns whereas individuals displayed a negative slope. Foreigners, however, bought regardless of previous returns. Moreover, LSV herding measure increased in all investor groups.

Keywords: North Korea, nuclear test, market destabilization, positive feedback trading, herding behavior

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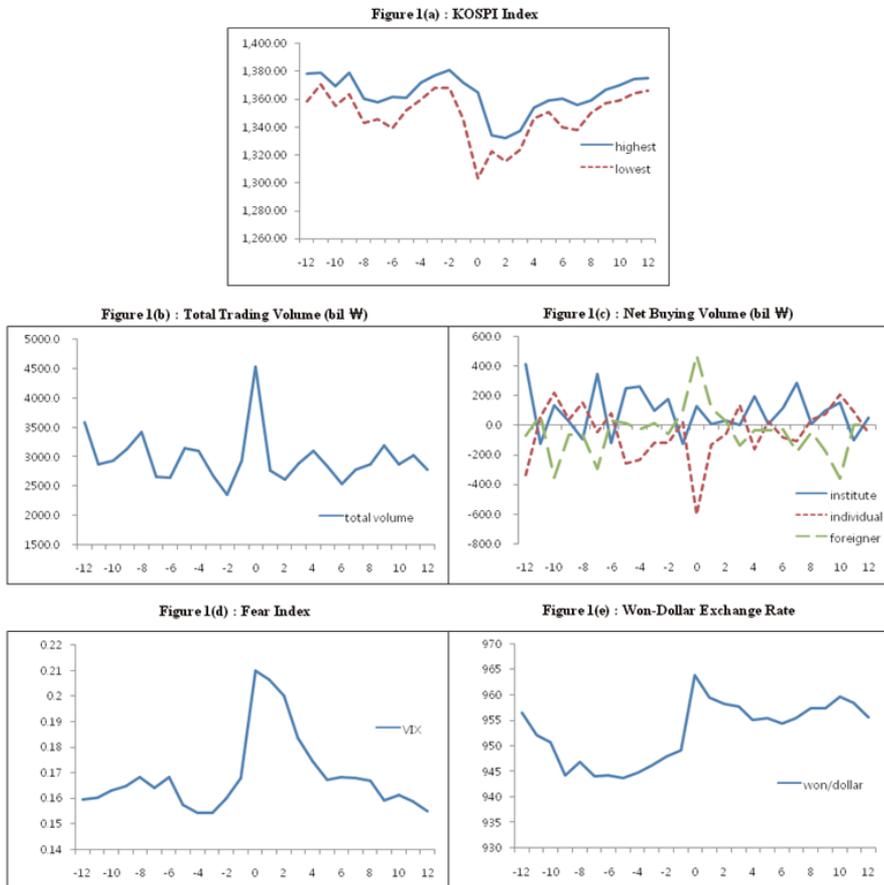
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INTRODUCTION

On October 9th, 2006, North Korea conducted a nuclear test to which world leaders publicly denounced and expressed concern over. The Korean stock market experienced a sudden drop in tandem with the increased negative media reports on North Korea. Figure 1 shows the situation of the financial market of South Korea around that day; the KOSPI index plummeted as trading volume increased with an almost doubling of stocks sold compared to the previous day. Domestic individual sold stocks, but foreign investors bought stocks. VIX which is calculated from the KOSPI 200 index options to represent the overall volatility of the market increased by more than 4% compared to that of the previous day. Thus, we can observe that the increased VIX measurement reflects an increased state of uncertainty in the investors in the market. This is further demonstrated in the sharp depreciation of the won against the US dollar, falling 2% in one day.

North Korea has threatened the world with the nuclear weapons several times since 1991. From 2000 to 2006, there were seven verbal threats and one actual test; seven verbal nuclear threats, which comprise of public statements issued by North Korea through the media, happened on October 17th, 2002, December 12th, 2002, January 10th, 2003, February 10th, 2005, May 11th, 2005, July 5th, 2006, and October 3rd, 2006. An actual test happened on October 9th, 2006. On days where verbal threats of nuclear action were made by North Korea, the market was unresponsive in terms of volatility. However, when the actual threat occurred on 9th October, 2006, there was a great deal of activity. The market was quick to drop its value and depreciate the won. However, interestingly, the market quickly relaxed as the true intentions of North Korea were revealed to foreign observers; that they wanted not to start a war but to open dialogues for negotiation. In Figure 1, we can observe temporary changes in the market around the actual nuclear test day.

This study examines investors' trading behavior in response to the nuclear threat from North Korea in the South Korean stock market. Even though the overall market reaction represented in the Figure 1 seems to cool down several days after the event happens, there is a temporary destabilization that might happen because of some investors' collective trading behavior due to the fear of the nuclear



This figure describes the South Korean financial market around October 9th, 2006. The horizontal axis indicates trading days around the event day, which is the date zero. Figure 1(a) shows the highest and lowest daily KOSPI index. Figure 1(b) and 1(c) represent total trading volume and net buying of each investor group in the stock market. Figure 1(d) and 1(e) depict fear index and won/dollar exchange rate, respectively.

Figure 1. Descriptions of the Nuclear Test Event, October 9th, 2006

threat. Thus, we will first investigate how the three investor groups, domestic individual, domestic institute, and foreign investors, react to the nuclear threats. The net-buying and LSV(1992) herding measures are applied to examine investors' trading behavior. More specifically, we will examine which investor group reacts more

sensitively to the nuclear threats by looking at the degree of positive feedback trading and herding. In addition, we classify the nuclear threats into the one actual test and the seven verbal threats made at other times and compare trading activities of investors with those in the peaceful period of 2004. To do this, investors trading activities during the two nuclear threats periods are compared to those during the peaceful period. Although newspapers and television have dealt with the nuclear threat a lot, there is no study investigating the real impact on the financial market. To our knowledge, this study is the first try to examine the effect of the nuclear threat on the market.

Not only will this study analyze the effect of the nuclear threat from North Korea on the market, but also aims to give a better understanding of market participants' trading in response to the threat. More specifically, with the results of this study, we can infer how each investor group differently interprets the impact of the nuclear threat from North Korea on the stock market of South Korea. In addition, based on observed trading behavior of each investor group during the threat period, we can make a conjecture on ex post trading performance of each group around the threat. However, because this study is a clinical study with one actual and seven verbal threats, we cannot generalize the trading pattern of investor groups and impact on the market for the nuclear threat. Hence, with caution, the results of this paper should be interpreted for the anticipation of the impact of future nuclear threats on the market. As this is the first study for the impact on the market due to the nuclear threat, it explains the market situation at that event time and can be indicative of the market reaction in the future.

The remainder of this article is organized as follows. We first summarize the chronology of the nuclear threats from North Korea and existing literature about positive feedback trading and herding in section 2 and section 3, respectively. Empirical method used in this study is explained in section 4. In section 5 we describe the data used in our analysis. We show empirical results in section 6. Finally, section 7 summarizes and presents concluding remarks.

THE CHRONOLOGY OF THE NUCLEAR THREATS FROM NORTH KOREA

The nuclear problem has existed a long time ago. Since 1992,

U.S. and North Korea had had many negotiations for nuclear inspection of International Atomic Energy Agency (IAEA) but all of them ruptured. In May 1994, North Korea began to remove spent fuel to get some nuclear material. In the next month, North Korea announced its withdrawal from the IAEA. Thus, Former U.S. President Jimmy Carter visited to North Korea and had a settlement.

In October 1994, The United States and North Korea adopted the Agreed Framework in Geneva. In the result of the agreement, North Korea froze its nuclear facilities and allowed IAEA special inspections. In exchange, U.S. and other countries promised to offer two light-water reactors and annual shipments of heavy fuel oil. The first nuclear crisis calmed down in that way.

In October 2002, the second crisis started with the dispatching the U.S. envoy, James Kelly. He claimed that North Korea had a furtive uranium enrichment program. North Korea responded that North Korea is entitled to possess not only nuclear weapons but other types of weapons more powerful than them in defense of its sovereignty in face of the U.S. threat.¹⁾ U.S. interrupted her aid to North Korea. North Korea also quitted the nuclear Non-Proliferation Treaty (NPT). The Geneva agreement was totally broken. Although six-party talks²⁾ held thrice, U.S. and North Korea stood at very different standpoints and there was no progress.

In February 2005, North Korea declared her possession of nuclear weapons for the sake of self defense and indefinite postponement of six-party talks. In April and May the same year, the tension between U.S. and North Korea was increased. Furthermore, North Korea tried to remove spent fuel again. However, the conflict was mitigated as the fourth six-party talks had held from July to September.

During the fourth round of six-party talks, U.S. department of treasury raised the question that North Korea had distributed counterfeit money through Banco Delta Asia (BDA). Immediately after the six party talks, U.S. blockaded North Korean capital in BDA. The relation between the two countries was aggravated seriously. The first stage of the fifth six-party talks terminated without advance. Moreover, U.S. refused continuing negotiation request of North Korea about BDA problem.

1) Source: Reuters news

2) The participants of six-party talks are U.S, China, Japan, Russia, South and North Korea.

Table 1. The Chronology of Nuclear Threats from North Korea

Dec-91	The agreement of denuclearisation was ratified. The Two Koreas also agreed to mutual inspections.
Sep-92	IAEA inspectors discovered some suspicious errors in North Korea's initial report on its nuclear program.
Feb-93	The IAEA demanded special inspections but North Korea refused.
Mar-93	North Korea announces its intention to withdraw from the NPT in three months
Jun-93	After talks with U.S., North Korea postponed its decision to break away from the NPT.
Mar-94	IAEA inspectors visit to North Korea. North Korea refused to allow inspections of a plutonium reprocessing plant at Yongbyon.
May-94	North Korea began to remove spent fuel to get some nuclear material.
Jun-94	North Korea announced its withdrawal from the IAEA. Former U.S. President Jimmy Carter visited to North Korea and had a settlement.
Oct-94	The Geneva agreement was ratified. North Korea froze its nuclear facilities and allowed IAEA special inspections. In exchange, U.S. and other countries promised to offer some aids.
Oct-02	The U.S. envoy, James Kelly, claimed that North Korea had a furtive uranium enrichment program.
Dec-02	U.S. interrupted annual shipments of heavy fuel oil to North Korea.
Jan-03	North Korea quitted the nuclear Non-Proliferation Treaty (NPT).
Aug-03	The first six party talks held.
Feb-04	The second six party talks held.
Jun-04	The third six party talks held.
Feb-05	North Korea declared her possession of nuclear weapons for the sake of self defense and indefinite postponement of six-party talks.
May-05	North Korea tried to remove spent fuel again.
Jul-Sep-05	The fourth six party talks held.
Sep-05	U.S. department of treasury raised the question that North Korea had distributed counterfeit money through Banco Delta Asia (BDA). U.S. blockaded North Korean capital in BDA.

Table 1. Continued

Nov-05	The first stage of the fifth six-party talks terminated without advance.
Jun-06	North Korea invited the U.S. chief envoy of six-party talks but refused.
Jul 5th, 06	North Korea launched missiles from its east coast, including long ranged missile, Taepodong-2.
Jul-06	U.N. Security Council adopted Resolution 1695 to give warning against its ballistic missile program.
Sep-06	24 international financial institutions including chinese interrupted deal with North Korea.
Oct 3rd, 06	North Korea said that the country will conduct its first nuclear test but gave no date.
Oct 9th, 06	North Korea conducted an underground nuclear test.
Oct-06	U.N. Security Council adopted Resolution 1718 to give some penalty for North Korea.
Dec-06	The second stage of the fifth six-party talks held

On July 5th, 2006, North Korea launched missiles from its east coast, including long ranged missile, Taepodong-2. In the same month, U.N. Security Council adopted Resolution 1695 to give warning against its ballistic missile program. U.S and other countries kept the pressures on, North Korea defied the pressures. On October 3rd, 2006, North Korea said that the country will conduct its first nuclear test but gave no date. Eventually, on October 9th, 2006, North Korea conducted an underground nuclear test. Table 1 summarizes the chronology of nuclear threats from North Korea.

LITERATURE REVIEW

Existing literature presents us with two major trading styles to explain how the actions of particular groups of investors impact and destabilize markets; the positive feedback trading style and herding trading style.

Positive feedback trading is where investors buy when the price goes up and sell when the price goes down. This kind of trading can

make deviate the price from its fundamental value. This trading can increase the volatility of asset values and as such destabilize the market. De Long, Shleifer, Summers, and Waldmann (1990)'s theoretical model shows that noise traders can deteriorate market efficiency by involving themselves in positive feedback trading. After their study, many researchers continued empirical and theoretical research on the impact of positive feedback trading in the market. This research had a particular focus on which investor groups conduct positive feedback trading and their return on that trading strategy. Grinblatt, Titman, and Wermers (1995) observe institutional investors' positive feedback trading. Nofsinger and Sias (1999) report that institutional investors are more likely to conduct positive feedback trading than individuals and that institutional investors' trades have positive impact on returns. Griffin, Harris, and Topaloglu (2003) also confirm the frequency of institutional investors' positive trading and show, on a minute level, their trading has some predictive power on future returns. In their study, they document individual investors conducting contrarian trading, buying after the price falls and selling after the price rises. This behavior among individual's trading style has also been observed in Odean (1998), Barber and Odean (2000), Grinblatt and Kelharju (2000).

Collective buying or selling from a particular investor group is called herding. Herding can be caused through five reasons; institutional traders' positive feedback trades, trades based on trading strategy of some investor group according to the style of characteristics of firms, trades acting like other managers to keep up reputation, trades based on inferred information from other investors, and trades with trading strategy made by similar analyzing tools and correlated information (Choi and Sias, 2009; Wermers, 1999). Lakonishok, Shleifer and Vishny (1992) and Sias(2004) introduce well known herding measure, Hwang and Salmon (2004) introduces CAPM style herding measure. Like positive feedback trading, herding can cause volatility problems in a market because of consecutive and dense trades in one direction which leads the price to deviate from its fundamental value.

Several studies examine the impact of positive feedback trading and herding behavior on the market's stability when financial crisis or economic stress occurs. Cohen and Shin (2004) observe trading behaviors when an economy is under stress, and document that

these trading styles become more extreme as a market increase in volatility. Choe, Kho, and Stulz (1999) examine whether foreign investors destabilize the market by conducting positive feedback trading and herding during the 1997 Korean financial crisis. In their results, foreign investors (classed as international based foreign investors and domestic based foreign investors) showed patterns of positive feedback trading and herding trading style prior to the crisis, but during the crisis, levels of positive feedback trading and herding significantly decreased. They conclude that foreign trading did not add to the volatility of the market in the crisis. However, Kim and Wei (2002) observe instance of strong positive feedback trading and herding behavior by non-resident foreign investors and imply that the trading behaviors of this group increase market volatility.

This study examines the impact that investor groups (domestic individual, domestic institution, and foreign investors) may or may not contribute to market destabilization during periods of nuclear threat from North Korea by examining changes in their positive feedback trading and herding behavior.

METHODOLOGY

Variables

Groups of investors

First, we divided investors into two groups, domestic and foreign investors. This is because most of domestic investors tend to concentrate their portfolios to the assets in their residential country. On the contrary, large international investor's portfolios are diversified all around the world. Thus, domestic and foreign investors' risk structures are different from each other. Additionally, most of individual investors are small investors and their willingness to pay for information, especially military intelligence, is much lower than domestic institutions and foreigners. Even if they get some military intelligence, they do not possess the ability to incorporate the information into their decision makings. Therefore, the information of individual is inaccurate relatively. So we separate individuals from domestic investors. Here we have three groups of investor, domestic individual, domestic institution, and foreign investors.

Firm size

It is a well known fact that foreign investors usually trade large firm's stocks in emerging market. Moreover, large stocks have high liquidity. So we expect to observe what we want to see in large stocks. We classify the stock size as small 30%, medium 40% and big 30% by market capitalization.

30 minute lagged return

The nuclear threats investigated in this article are sudden shocks to the South Korean market. However, the impact of the threats did not last long. Even for the actual nuclear test occurred at October 9th 2006, right after the intention of North Korea revealed, the panic of the market was cool down in only a few days. Therefore, to gaze the market reaction, we need a dense time interval. So we choose 30 minute interval. The beginning of the market is 9:00 AM and the closing is 3:00 PM. We split trading day into 12 intervals and calculate log returns each stock and each interval, respectively. To get the first interval returns, we use closing price the day before. We divide returns into 7 levels into (-100%,-1%), [-1%,-0.5%), [-0.5%,-0.1%), [-0.1%, 0.1%), [0.1%, 0.5%), [0.5%, 1%), [1%, ∞). To get results conditioning on lagged returns, we do not use the first period trading volume and net buy. Then, we have 11 observations for a stock in a day. We have also performed the same examinations with 5 minute time intervals. Because the investigation with 5 minute time intervals shows consistent results to that with 30 minute time intervals, only the results for 30 minute time intervals are reported. The reason why we have chosen 30 minute time intervals is that trading patterns of three investor groups conditional on lagged returns are more clearly shown in that time interval because returns for the unit time intervals are more evenly distributed; for the 5 minute time interval, more than 70% of returns for the unit time interval is located within -0.1% to 0.1%.

For example, if a stock j 's the day before closing price is 10,000 won and the price at 9:30AM is 10,200 won, then the log return of the first interval, 9:00~9:30AM, is $\ln(10,200/10,000) = 1.98\%$. This return belongs to the return interval $[1\%, \infty)$. If we get some certain numeric measure in the second interval, 9:30~10:00AM, then we analyze the value conditioning on the return of first interval, $[1\%, \infty)$.

Because of data availability, most of fund herding research used quarterly data. Using the quarterly data has a problem that herding

behavior can be occurred in the shorter interval and can be missed. Puckett and Yan (2008) used weekly data, and they showed that herding measures become larger when period becomes shorter.

NYSE weekly return

Richards (2005) reported that foreign investors and external conditions have a significant effect on emerging markets. Froot, O'connell and Seasholes (2001) noted that the slope of local stock prices change to foreign inflows is positive and cannot be ignored. Thus, we divide weeks into two groups by weekly NYSE return, positive or negative. It can control the external effect parsimoniously.

Every trading day has 12 intervals, 11 observations and about 650~700 listed stocks. Therefore, we have 7150~7700 observations each day, approximately. Observations are classified by firm size, 30 minute lagged return and NYSE weekly return. We pool the observations and calculate the average of the measures in the same classification.

Measures

Net buy

There have been many complicate literatures about positive feedback trading. However, the net buy measure is the easiest to implement and interpret. So we calculate the net buy of the three investor groups. Let $B(i, j, t)$ be the total amount of investors in a group i that who purchase the stock j in interval t . $S(i, j, t)$ is defined similarly. Then the net buy of group i in the stock j , interval t is defined as

$$\frac{B(i, j, t) - S(i, j, t)}{\sum_{i=1}^3 (B(i, j, t) + S(i, j, t)) / 2}$$

The measure is normalized by the total trade volume given stock j in interval t .

LSV herding measure.

We use the well known LSV(1992) herding measure. Previous to use the measure, we summarize the idea of LSV briefly. Let $b(i, j, t)$ be the number of investors in a group i that who purchase

the stock j in interval t . $s(i, j, t)$ is defined similarly. Let $p(i, j, t)$ is the ratio of the buyer number and the active trader number. i.e., $p(i, j, t)$ is the inclination to buy for given i, j, t . LSV assumed that there are only active traders who buy or sell and a trade executed given i, j, t follows a Bernoulli distribution with $p(i, j, t)$. The most critical assumption of LSV measure is an investor group has a same inclination to buy across all the stocks j in interval t , if there is no herding. i.e., $p(i, t) = p(i, j, t), \forall j$.

$$H(i, j, t) = |p(i, j, t) - p(i, t)| - E[|p(i, j, t) - p(i, t)|]$$

$$p(i, j, t) = \frac{b(i, j, t)}{b(i, j, t) + s(i, j, t)}$$

$$p(i, t) = \frac{\sum_{j=1}^J b(i, j, t)}{\sum_{j=1}^J b(i, j, t) + \sum_{j=1}^J s(i, j, t)}$$

We can regard $p(i, t)$ as the empirical expectation of $p(i, j, t)$. i.e., $p(i, t) = E[p(i, j, t)]$. Since the first term of herding measure $H(i, j, t)$ has a nonzero mean, so we have to subtract some adjustment factor. Let $b(i, j, t) + s(i, j, t) = n(i, j, t)$ and assume that $b(i, j, t) \sim \text{bin}(n(i, j, t), p(i, t))$ then we can calculate the second term. If $n(i, j, t)$ is large, we can approximate the binomial as a normal.

As noted above LSV measure has the assumption that if $p(i, t) = E[p(i, j, t)]$ then there is no herding even though $p(i, t)$ varies on time t . Usually, when $p(i, j, t)$ and $p(i, t)$ move to same direction, we can interpret that case as the investor follows fundamental of economy. i.e., it is not a herding.

However, there exists a possibility that short-run panic or boom occurs as $p(i, j, t)$ and $p(i, t)$ move to same direction, without fundamental change. We consider that the event we concerned is in the case. So we have to be careful to interpret the measure. We can under-estimate the actual herding phenomena because average behavior also varies.

By the assumption of the binomial distribution, $b(i, j, t) \sim \text{bin}(n(i, j, t), p(i, t))$ we can calculate the second term of herding measure. Let's abbreviate $b(i, j, t) = b$, $n(i, j, t) = n$, $p(i, t) = p$, then we can write the second term as

$$E[p(i, j, t) - p(i, t)] = E\left[\frac{b}{n} - p\right] = \sum_{k=1}^n \left|\frac{k}{n} - p\right| {}_n C_k p^k (1-p)^{n-k}$$

Usually, if n is larger than 30, we use the approximation $b \sim N(np, np(1-p))$. thus,

$$X = \frac{b}{n} - p \sim N\left(0, \frac{p(1-p)}{n}\right), \sigma = \sqrt{\frac{p(1-p)}{n}}$$

$$\begin{aligned} E[|X|] &= \frac{2}{\sqrt{2\pi}\sigma} \int_0^{\infty} x e^{-\frac{x^2}{2\sigma^2}} dx \\ &= \frac{2\sigma}{\sqrt{2\pi}} \\ &= 2\sqrt{\frac{p(1-p)}{2\pi n}} \end{aligned}$$

For example, if $p = 1$, then the first term is zero and the second term is also zero. Therefore, LSV herding measure becomes also zero. In other words, a group of investors only buy all the stocks in a market but the measure is zero.

DATA

This study uses data from October 2002 to October 2006. During that period, seven verbal nuclear threatening and one actual nuclear test occurred. Seven verbal nuclear threatening happened at October 17th, 2002, December 12th, 2002, January 10th, 2003, February 10th, 2005, May 11th, 2005, July 5th, 2006, and October 3rd, 2006. The nuclear test of the actual threat event happened at October 9th, 2006. Although the first actual nuclear threat occurred in 1994, because of limited availability of data, we analyze the impact of the actual threat only with the data from 2006. In 1994, foreigners were subjected to restrictions that specified they could only hold up to 12% of the total market value of individual Korean stocks. Therefore, the response of foreigners to the actual nuclear threat in 1994 could be different to that in 2006.

Korea Stock Exchange (KSE) trading tick data were obtained from

Korea Exchange (KRX).³⁾ All stock transaction occurred in KRX during our sample period are recorded; transaction prices, trading volume, trading time, and investors information about nationality and kinds of investor group. Thus, from the data, we can distinguish investors into domestic institute, domestic individuals and foreigners. We also get the option tick data form KRX, to calculate VIX fear index and other data used to draw descriptive figure comes from the same source. From Markit data, we get the spread on the yield of Korea's foreign exchange stabilization bonds.

We also obtained quarterly market capitalization and daily, quarterly closing price of each stock⁴⁾. Quarterly market capitalization and closing prices are used to classify stocks into three groups, small 30%, medium 40% and big 30%. Stocks which price below 500 won are discarded because it might behave strange. And then, the remaining stocks are sorted by capitalization. The daily closing prices are regarded as the next day beginning price and those are used to calculate first 30 minute returns of each stock.

From Wharton Research Data Service (WRDS), we got the NYSE daily index level data and calculate weekly return, a Friday closing to the next Friday closing. We dichotomize the weeks by return, positive or negative. Thus we can control the effect of external business condition roughly.

RESULT

We compared the days nuclear threatening happened and the next days with the period between July 2003 and December 2004. The period was relatively peaceful, although some troubles happened. Therefore, we choose the period as a benchmark.

Result of net buying measure

Table2 describes net buying behaviors of group of investors in 2003. 7~2004. 12. The vertical axis of a table is about timing. 'Positive' means that an interval t belongs to the week when the NYSE return is positive. 'Negative' has the similar meaning. The

3) <http://www.krx.co.kr/>

4) Data guide pro(<http://www.dataguidepro.com/>)

Table 2. Net buying in the Benchmark Period

	30 minute Lagged return (%)	institute			individual			foreigner			
		small	medium	big	small	medium	big	small	medium	big	
Panel A	(-1)	0.063 (0.059)	-0.314 (0.115)	-6.699 (0.2)	-0.097 (0.062)	0.266 (0.128)	8.225 (0.215)	0.034 (0.021)	0.049 (0.064)	-1.527 (0.154)	
	(-1,-0.5)	-0.072 (0.083)	0.25 (0.128)	-5.166 (0.179)	0.072 (0.088)	-0.74 (0.143)	4.439 (0.194)	-0.001 (0.03)	0.491 (0.073)	0.727 (0.148)	
	Negative NYSE weekly return	(-0.5,-0.1)	0.22 (0.088)	0.43 (0.127)	-3.344 (0.133)	-0.238 (0.095)	-1.155 (0.142)	1.106 (0.143)	0.018 (0.036)	0.725 (0.076)	2.239 (0.114)
		(-0.1,0.1)	0.13 (0.029)	1.298 (0.061)	-0.2 (0.121)	-0.135 (0.031)	-2.038 (0.067)	-3.22 (0.129)	0.005 (0.01)	0.74 (0.034)	3.419 (0.101)
		(0.1,0.5)	0.291 (0.103)	1.9 (0.142)	0.637 (0.144)	-0.277 (0.111)	-2.648 (0.157)	-5.022 (0.152)	-0.013 (0.041)	0.749 (0.081)	4.386 (0.123)
		(0.5,1)	0.185 (0.092)	2.064 (0.151)	4.248 (0.202)	-0.224 (0.098)	-2.941 (0.165)	-9.627 (0.21)	0.039 (0.033)	0.878 (0.08)	5.379 (0.159)
		(1~)	0.039 (0.06)	1.821 (0.123)	5.247 (0.215)	-0.099 (0.064)	-2.835 (0.134)	-11.4 (0.226)	0.061 (0.022)	1.014 (0.065)	6.157 (0.165)
Panel B	(-1)	0.092 (0.048)	0.432 (0.094)	-4.423 (0.183)	-0.095 (0.051)	-0.668 (0.103)	5.505 (0.197)	0.004 (0.018)	0.236 (0.049)	-1.082 (0.133)	
	(-1,-0.5)	0.178 (0.065)	0.536 (0.099)	-3.117 (0.142)	-0.181 (0.07)	-1.041 (0.11)	2.437 (0.151)	0.004 (0.027)	0.506 (0.056)	0.679 (0.114)	
	Positive NYSE weekly return	(-0.5,-0.1)	0.189 (0.073)	0.9 (0.095)	-1.235 (0.103)	-0.289 (0.078)	-1.45 (0.106)	-0.827 (0.111)	0.1 (0.03)	0.55 (0.056)	2.062 (0.087)
		(-0.1,0.1)	0.166 (0.024)	1.536 (0.048)	1.733 (0.095)	-0.178 (0.025)	-2.22 (0.052)	-4.402 (0.102)	0.012 (0.009)	0.683 (0.026)	2.669 (0.078)
		(0.1,0.5)	0.192 (0.079)	2.252 (0.103)	2.858 (0.11)	-0.183 (0.085)	-3.196 (0.116)	-6.92 (0.116)	-0.009 (0.032)	0.944 (0.062)	4.063 (0.093)
		(0.5,1)	0.209 (0.07)	2.382 (0.11)	5.44 (0.154)	-0.234 (0.075)	-3.383 (0.121)	-10.37 (0.162)	0.026 (0.029)	1.001 (0.061)	4.932 (0.121)
		(1~)	0.133 (0.048)	2.217 (0.096)	6.489 (0.165)	-0.168 (0.051)	-3.29 (0.105)	-12.29 (0.173)	0.035 (0.017)	1.074 (0.05)	5.798 (0.125)

The table reports net buying behavior of each investor group in the benchmark period 2003.7~2004.12. Each column belongs to an investor group shows how the investor group behaves by firm size. Panel A represents the result when NYSE weekly return is negative. Similarly, Panel B represents the result when NYSE weekly return is positive. The net buying behavior of each column is divided into 7 categories of 30 minute lagged return. Every number of the table is reported in percentage and every number in parenthesis is the standard deviation of the above number.

vertical axis also contains the information about lagged 30 minute return of stocks. The horizontal axis of a table is about investors groups and firm sizes. Note that most of phenomena which we want to see are revealed distinctly in big size. Every number in table is presented in percentage. The numbers above are the mean of the measures in a certain classification and the parenthesized numbers are the standard deviation of the measures. This format about table is applied for all rest of the table.

In table 2, when lagged returns are negative, institutes and foreigners tend to sell and individuals appear to buy shares. These trading patterns of three investor groups conditioning on lagged returns seem to be intensified as a firm size becomes large. Therefore we can say that institutes and foreigners are positive feedback traders, individuals are contrarian in that period. This feature is consistent with previous literature (Griffin, Harris, and Topaloglu, 2003; Grinblatt, Titman, and Wermers, 1995; Nofsinger and Sias, 1999). Moreover, the degree of positive feedback trading of institutes is stronger than that of foreigners.

Richards (2005) argue that NYSE index impact positively the performance of large companies' shares in the Korean stock market. In addition, the ownership of institutes in large companies is relatively greater than that of institutes in small or medium companies. Therefore, we can guess that institutes would trade in response to changes in NYSE index. For individual investors, because of their contrarian investing, opposite response to NYSE weekly return with institutes are predicted. In table 2, consistent with our prediction, institutes (individuals) tend to buy (sell) more a little bit when NYSE weekly return is positive. On the other hand, institutes (individuals) seem to sell (buy) more when NYSE weekly return is negative. Foreigners strengthen positive feedback trading when NYSE weekly return is negative. It can be interpreted that foreigners become more sensitive to the Korean market movement during the negative NYSE weekly return period because Korean economy is devalued and the market volatility get raised when NYSE weekly return is negative.

Table 3 shows net buying behaviors on seven verbal nuclear threatening event days and their next days.

Like in Table 2, institutes and foreigners do positive feedback trading and individuals do contrarian trading. However, dependency of trading on lagged return for days of negative NYSE weekly return

Table 3. Net buying in the Verbal Threat Event Period

	30 minute Lagged return (%)	institute			individual			foreigner			
		small	medium	big	small	medium	big	small	medium	big	
Panel A	(~-1)	0.826 (0.339)	-1.031 (0.646)	-12.937 (1.199)	-0.077 (0.384)	1.478 (0.711)	16.171 (1.205)	-0.749 (0.179)	-0.448 (0.378)	-3.234 (0.819)	
	(-1,-0.5)	0.533 (0.423)	-0.918 (0.665)	-6.160 (1.011)	0.375 (0.456)	1.145 (0.719)	7.858 (1.029)	-0.908 (0.171)	-0.228 (0.38)	-1.698 (0.735)	
	Negative NYSE weekly return	(-0.5,-0.1)	1.578 (0.472)	0.585 (0.539)	-3.872 (0.671)	-0.580 (0.517)	0.448 (0.613)	3.480 (0.682)	-0.998 (0.241)	-1.033 (0.365)	0.393 (0.555)
		(-0.1,-0.1)	1.239 (0.196)	3.253 (0.336)	-0.249 (0.595)	-0.943 (0.205)	-3.550 (0.363)	-0.611 (0.616)	-0.296 (0.06)	0.296 (0.191)	0.861 (0.481)
		(0.1,0.5)	0.936 (0.494)	2.323 (0.646)	2.428 (0.727)	-0.209 (0.543)	-2.366 (0.695)	-5.426 (0.727)	-0.728 (0.226)	0.042 (0.371)	2.998 (0.584)
		(0.5,1)	0.445 (0.402)	4.849 (0.718)	4.138 (1.139)	0.103 (0.457)	-4.792 (0.789)	-7.990 (1.1)	-0.547 (0.227)	-0.057 (0.389)	3.852 (0.827)
		(1~)	1.005 (0.345)	4.548 (0.83)	5.934 (1.437)	-0.745 (0.37)	-4.702 (0.873)	-10.882 (1.386)	-0.260 (0.131)	0.154 (0.438)	4.948 (0.935)
Panel B	(~-1)	0.084 (0.265)	0.312 (0.53)	-4.181 (0.971)	0.235 (0.3)	0.410 (0.573)	4.518 (1.058)	-0.319 (0.142)	-0.722 (0.243)	-0.337 (0.734)	
	(-1,-0.5)	0.457 (0.415)	-0.525 (0.582)	-4.346 (0.944)	0.027 (0.47)	0.817 (0.647)	3.204 (1.031)	-0.483 (0.221)	-0.292 (0.349)	1.143 (0.738)	
	Positive NYSE weekly return	(-0.5,-0.1)	0.955 (0.439)	0.721 (0.56)	-5.204 (0.717)	-0.626 (0.464)	0.461 (0.651)	1.295 (0.793)	-0.328 (0.16)	-1.182 (0.404)	3.909 (0.62)
		(-0.1,-0.1)	0.839 (0.242)	2.289 (0.359)	-2.020 (0.615)	-0.666 (0.262)	-1.607 (0.396)	-1.276 (0.677)	-0.173 (0.108)	-0.682 (0.205)	3.296 (0.515)
		(0.1,0.5)	0.199 (0.458)	0.980 (0.59)	-0.299 (0.759)	0.409 (0.515)	-0.005 (0.682)	-5.539 (0.791)	-0.607 (0.238)	-0.974 (0.415)	5.838 (0.619)
		(0.5,1)	0.541 (0.407)	0.990 (0.602)	2.255 (0.88)	-0.279 (0.432)	-0.224 (0.668)	-7.176 (0.973)	-0.263 (0.148)	-0.766 (0.365)	4.921 (0.738)
		(1~)	0.363 (0.244)	1.637 (0.475)	4.969 (0.774)	-0.351 (0.263)	-1.322 (0.504)	-10.414 (0.865)	-0.011 (0.097)	-0.315 (0.24)	5.445 (0.62)

The table reports net buying behavior of each investor group in the seven verbal nuclear threatening events' periods. Each column belongs to an investor group shows how the investor group behaves by firm size. Panel A represents the result when NYSE weekly return is negative. Similarly, Panel B represents the result when NYSE weekly return is positive. The net buying behavior of each column is divided into 7 categories of 30 minute lagged return. Every number of the table is reported in percentage and every number in parenthesis is the standard deviation of the above number.

Table 4. Net buying in the Actual Nuclear Test Event Period

	30 minute Lagged return (%)	institute			individual			foreigner		
		small	medium	big	small	medium	big	small	medium	big
Positive NYSE weekly return	(~-1)	1.232 (0.554)	5.329 (0.788)	3.002 (1.317)	-1.169 (0.596)	-5.938 (0.913)	-6.301 (1.483)	-0.063 (0.222)	0.609 (0.497)	3.299 (1.193)
	(-1,-0.5)	3.963 (1.005)	5.112 (1.103)	0.45 (1.225)	-4.472 (1.046)	-7.548 (1.31)	-5.953 (1.334)	0.509 (0.356)	2.436 (0.816)	5.504 (1.211)
	(-0.5,-0.1)	4.784 (1.14)	5.732 (1.106)	0.095 (0.934)	-4.962 (1.173)	-9.282 (1.244)	-8.94 (1.012)	0.179 (0.265)	3.551 (0.694)	8.845 (0.941)
	(-0.1,0.1)	3.878 (0.564)	6.71 (0.789)	1.579 (0.997)	-4.475 (0.583)	-9.017 (0.854)	-9.763 (1.084)	0.597 (0.167)	2.308 (0.451)	8.184 (0.995)
	(0.1,0.5)	3.475 (1.328)	7.476 (1.403)	4.545 (1.407)	-4.276 (1.364)	-11.113 (1.546)	-14.525 (1.395)	0.801 (0.435)	3.637 (0.82)	9.979 (1.25)
	(0.5,1)	2.216 (1.23)	5.523 (1.35)	9.751 (1.912)	-3.782 (1.281)	-9.573 (1.675)	-17.561 (1.984)	1.566 (0.448)	4.051 (1.09)	7.809 (1.702)
	(1~)	3.044 (0.876)	8.274 (1.155)	15.318 (1.722)	-4.269 (0.911)	-12.319 (1.272)	-22.572 (1.736)	1.225 (0.307)	4.046 (0.772)	7.254 (1.543)

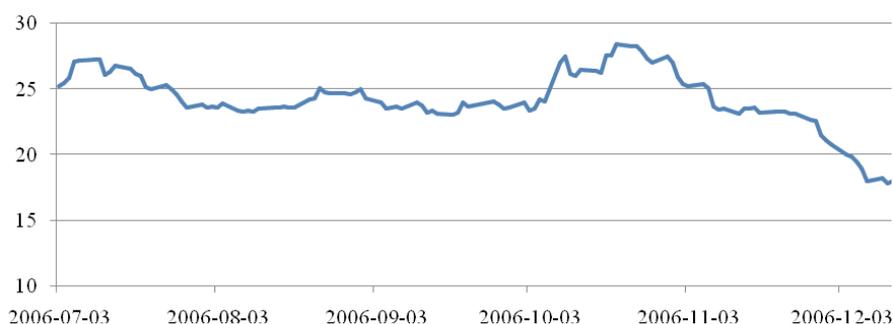
The table reports net buying behavior of each investor group in the actual nuclear threatening event period. Each column belongs to an investor group shows how the investor group behaves by firm size. The event period is comprised in the weeks of positive NYSE return. The net buying behavior of each column is divided into 7 categories of 30 minute lagged return. Every number of the table is reported in percentage and every number in parenthesis is the standard deviation of the above number.

is much more strengthened than for positive NYSE weekly return. In particular, as lagged returns become low, positive feedback trading and contrarian trading seem to be intensified. The net buying of institutes conditioning on lagged returns less than -1% when NYSE weekly return is negative is -12.937 which is three times as big as that when NYSE weekly return is positive. This may be caused by temporal increase of uncertainty of the Korean stock market due to verbal threats from North Korea. In other words, verbal threats would make the market more disturbed when the performance of NYSE index is not good.

Table 4 shows net buying behaviors on October 9th and 10th, 2006 when the actual nuclear threat occurred. At the week when

the threat happened, NYSE weekly return was positive, so Table 4 shows the case only for positive NYSE weekly return. In that time, foreigners had a tendency to buy stocks, regardless of previous lagged return, instead of positive feedback trading. More specifically, even though the lagged return of a stock was negative, they had an inclination to buy the stock. They changed their own behavior. The domestic institutes increase their net buy but they still have slopes to lagged return level. Compared to Table 2, institutes and foreigners bought more, and individuals sold more than the benchmark period.

In summary, in the peaceful period used for the benchmark period, institutes and foreigners seem to do positive feedback trading and individuals do contrarian investing. When verbal nuclear threats occurred, their trading patterns changed a little bit; when previous return is negative, positive feedback trading by institutes and foreigners and contrarian trading by individuals become more intensified than the benchmark period. However, on October 9th, 2006, of the actual nuclear threat day, the tendency of trading dependent on lagged returns almost disappeared. Regardless of previous 30 minute return, institutes and foreigners bought and individuals sold shares. This may be caused by differences in risk evaluation for the nuclear threat among investor groups. When the actual nuclear threat occurred, individuals would consider the threat as a realization of a war threat and expect the bear market for a long time so they sold shares, while institutes and foreigners



This figure describes the spread on the yield of Korea's foreign exchange stabilization bonds from July 3rd, 2006 to December 30th, 2006. The spread is represented by basis points.

Figure 2. The Spread on the Yield of Korea's Foreign Exchange Stabilization Bonds

might have tried to take advantage of the situation because they thought stocks had become temporarily undervalued. In fact, the actual threat seemed like it was not assessed seriously outside of Korea. Figure 2 shows the spread on the yield of Korea's foreign exchange stabilization bonds. In the graph, the spread around the threat raised by 3 to 4 basis points. However, this is a very little increase and insignificant change compared to the increase by 300 to 400 basis points in the late 2008 when the world-wide financial crisis happened. It is hard to say, with the evidence in this study, that institutions and foreigners bought stocks because they have superior information compared to individuals. However, we can say that institutions and foreigners' buying came from their expectation that the threat would be a temporal one.

Result of LSV herding measure

Like positive feedback trading, herding can represent how much investors destabilize the market. As investors collectively trade in one direction, herd measure becomes large and the value of stock can be deviate from its fundamental value. Moreover, in the crisis or emergent situation, herding can be prevailing because the characteristic of each investor group will stick out. Therefore, we expect that herding will be more prevalent during the period of the nuclear threats from North Korea. We first calculate LSV herding in the peaceful period, in seven verbal threats period, and in the actual nuclear test period, respectively. After then we will compare the results to see if herding really increases in the periods with nuclear threats.

Table 5 shows LSV herding in the benchmark period. Herding is more prevalent in the big size firms regardless of investor types and NYSE weekly returns. Especially, in the big size firms, foreigners' herding measures is relatively higher than the others. High herding of one particular group indicates that this group buys more some stocks and sells more other stocks to their mean behavior. It seems that foreigners followed a fad in that period or did collective buying or selling in the big size category. In addition, there are no significant differences in herding between the weeks of negative NYSE return and positive NYSE returns.

LSV herding measures for three investor groups in seven verbal threatening events are represented in Table 6. Panel A shows the

Table 5. LSV Herding in the Benchmark Period

	30 minute Lagged return (%)	institute			individual			foreigner		
		small	medium	big	small	medium	big	small	medium	big
Panel A Negative NYSE weekly return	(~-1)	0.914 (0.033)	2.616 (0.052)	6.911 (0.084)	-1.556 (0.052)	0.318 (0.053)	6.764 (0.069)	0.168 (0.013)	1.702 (0.037)	11.633 (0.107)
	(-1,-0.5)	0.876 (0.044)	2.935 (0.059)	7.617 (0.075)	-1.235 (0.073)	0.796 (0.058)	7.7 (0.064)	0.149 (0.017)	1.697 (0.04)	11.64 (0.091)
	(-0.5,-0.1)	0.786 (0.043)	3.257 (0.055)	8.276 (0.054)	-1.732 (0.076)	0.984 (0.054)	8.558 (0.048)	0.181 (0.019)	1.997 (0.039)	12.107 (0.065)
	(-0.1,0.1)	0.311 (0.01)	1.492 (0.02)	5.595 (0.045)	-2.277 (0.024)	-0.904 (0.027)	5.769 (0.046)	0.058 (0.004)	0.779 (0.013)	7.674 (0.051)
	(0.1,0.5)	0.96 (0.05)	3.556 (0.062)	8.297 (0.058)	-1.55 (0.083)	1.26 (0.059)	9.007 (0.054)	0.184 (0.021)	1.914 (0.04)	12.063 (0.068)
	(0.5,1)	0.895 (0.047)	3.273 (0.067)	8.115 (0.083)	-0.727 (0.078)	1.296 (0.066)	8.756 (0.075)	0.177 (0.021)	1.565 (0.041)	11.303 (0.094)
	(1~)	1.078 (0.038)	3.252 (0.06)	7.826 (0.093)	-0.257 (0.052)	1.458 (0.056)	8.285 (0.082)	0.206 (0.015)	1.639 (0.038)	11.396 (0.108)
Panel B Positive NYSE weekly return	(~-1)	0.768 (0.024)	2.638 (0.043)	6.808 (0.076)	-1.792 (0.044)	0.125 (0.045)	6.451 (0.064)	0.178 (0.011)	1.325 (0.028)	10.214 (0.092)
	(-1,-0.5)	0.709 (0.031)	2.923 (0.046)	7.787 (0.061)	-1.461 (0.059)	0.807 (0.046)	7.371 (0.051)	0.175 (0.015)	1.542 (0.03)	10.839 (0.072)
	(-0.5,-0.1)	0.731 (0.031)	3.221 (0.042)	8.395 (0.043)	-1.867 (0.06)	0.829 (0.041)	8.335 (0.038)	0.157 (0.014)	1.843 (0.029)	11.62 (0.05)
	(-0.1,0.1)	0.277 (0.007)	1.472 (0.016)	5.838 (0.036)	-2.472 (0.02)	-1.136 (0.021)	5.653 (0.036)	0.055 (0.003)	0.717 (0.01)	7.58 (0.04)
	(0.1,0.5)	0.77 (0.034)	3.398 (0.046)	8.647 (0.046)	-1.834 (0.064)	0.817 (0.044)	8.833 (0.041)	0.171 (0.015)	1.862 (0.031)	11.859 (0.052)
	(0.5,1)	0.825 (0.035)	3.109 (0.049)	8.424 (0.065)	-1.127 (0.061)	1.043 (0.049)	8.505 (0.058)	0.176 (0.015)	1.526 (0.031)	11.005 (0.073)
	(1~)	0.862 (0.027)	3.206 (0.047)	8.129 (0.074)	-0.585 (0.043)	1.262 (0.044)	7.819 (0.062)	0.202 (0.012)	1.524 (0.03)	11.037 (0.085)

The table reports herding behavior of each investor group in the benchmark period 2003.7~2004.12. Each column belongs to an investor group shows how the investor group behaves by firm size. Panel A represents the result when NYSE weekly return is negative. Similarly, Panel B represents the result when NYSE weekly return is positive. The herding behavior of each column is divided into 7 categories of 30 minute lagged return. Every number of the table is reported in percentage and every number in parenthesis is the standard deviation of the above number.

Table 6. LSV Herding in the Verbal Threat Event Period

	30 minute Lagged return (%)	institute			individual			foreigner		
		small	medium	big	small	medium	big	small	medium	big
Panel A Negative NYSE weekly return	(~-1)	0.845 (0.157)	3.538 (0.284)	10.535 (0.5)	-0.781 (0.26)	1.038 (0.274)	7.237 (0.384)	1.462 (0.169)	2.934 (0.231)	12.829 (0.597)
	(-1,-0.5)	0.902 (0.18)	3.751 (0.286)	10.843 (0.428)	-0.174 (0.305)	1.686 (0.26)	8.116 (0.344)	1.704 (0.209)	2.561 (0.226)	11.621 (0.467)
	(-0.5,-0.1)	0.921 (0.174)	4.064 (0.248)	10.526 (0.275)	-0.663 (0.313)	1.727 (0.228)	8.668 (0.229)	1.257 (0.183)	3.503 (0.207)	12.754 (0.308)
	(-0.1,-0.1)	0.460 (0.063)	2.235 (0.115)	8.018 (0.227)	-1.470 (0.129)	0.401 (0.136)	6.707 (0.211)	0.429 (0.046)	1.531 (0.084)	9.188 (0.249)
	(0.1,0.5)	1.051 (0.188)	4.195 (0.277)	9.977 (0.282)	-0.378 (0.366)	2.084 (0.264)	9.285 (0.261)	0.887 (0.167)	3.104 (0.221)	12.005 (0.314)
	(0.5,1)	0.927 (0.205)	3.821 (0.32)	10.547 (0.445)	-0.335 (0.327)	2.110 (0.313)	9.000 (0.418)	1.187 (0.19)	2.373 (0.236)	11.400 (0.475)
	(1~)	1.005 (0.191)	3.843 (0.323)	10.291 (0.55)	0.992 (0.282)	2.569 (0.32)	9.119 (0.461)	1.036 (0.157)	2.882 (0.261)	11.327 (0.608)
Panel B Positive NYSE weekly return	(~-1)	0.536 (0.124)	2.187 (0.241)	7.102 (0.427)	-0.572 (0.256)	0.701 (0.254)	6.253 (0.337)	0.469 (0.099)	1.794 (0.177)	9.369 (0.512)
	(-1,-0.5)	1.325 (0.231)	3.734 (0.308)	8.039 (0.427)	0.228 (0.31)	2.225 (0.277)	7.124 (0.32)	0.827 (0.168)	2.219 (0.228)	10.452 (0.479)
	(-0.5,-0.1)	0.997 (0.224)	4.405 (0.31)	9.113 (0.314)	0.156 (0.355)	2.404 (0.26)	8.810 (0.271)	0.680 (0.145)	3.553 (0.253)	11.127 (0.35)
	(-0.1,-0.1)	0.591 (0.084)	2.655 (0.156)	6.551 (0.253)	-0.814 (0.164)	0.156 (0.169)	6.137 (0.241)	0.338 (0.049)	1.557 (0.11)	7.462 (0.269)
	(0.1,0.5)	0.758 (0.207)	4.356 (0.315)	7.813 (0.305)	-0.424 (0.357)	2.017 (0.268)	9.068 (0.288)	0.618 (0.158)	2.812 (0.239)	11.218 (0.359)
	(0.5,1)	0.677 (0.202)	3.645 (0.34)	7.745 (0.402)	0.601 (0.344)	1.519 (0.293)	7.987 (0.366)	0.306 (0.109)	1.876 (0.234)	9.802 (0.467)
	(1~)	0.832 (0.155)	3.305 (0.289)	6.835 (0.392)	-0.138 (0.252)	1.568 (0.233)	7.123 (0.317)	0.332 (0.088)	1.825 (0.195)	9.725 (0.452)

The table reports herding behavior of each investor group in the seven verbal nuclear threatening events' periods. Each column belongs to an investor group shows how the investor group behaves by firm size. Panel A represents the result when NYSE weekly return is negative. Similarly, Panel B represents the result when NYSE weekly return is positive. The herding behavior of each column is divided into 7 categories of 30 minute lagged return. Every number of the table is reported in percentage and every number in parenthesis is the standard deviation of the above number.

Table 7. LSV Herding in the Actual Nuclear Test Event Period

	30 minute Lagged return (%)	institute			individual			foreigner		
		small	medium	big	small	medium	big	small	medium	big
Positive NYSE weekly return	(~ -1)	1.982 (0.31)	5.638 (0.399)	12.436 (0.654)	0.633 (0.324)	2.568 (0.326)	7.567 (0.464)	2.282 (0.29)	5.701 (0.402)	14.242 (0.738)
	(-1, -0.5)	2.679 (0.516)	7.563 (0.55)	13.146 (0.614)	0.999 (0.468)	4.36 (0.444)	9.079 (0.46)	2.905 (0.437)	6.98 (0.532)	14.17 (0.673)
	(-0.5, -0.1)	2.35 (0.483)	7.967 (0.492)	12.461 (0.451)	-0.19 (0.536)	3.94 (0.402)	10.547 (0.393)	1.219 (0.29)	5.972 (0.421)	14.758 (0.474)
	(-0.1, 0.1)	0.882 (0.16)	4.746 (0.296)	9.744 (0.431)	-0.845 (0.249)	1.488 (0.296)	9.794 (0.426)	0.796 (0.127)	3.459 (0.244)	11.024 (0.456)
	(0.1, 0.5)	0.819 (0.448)	7.752 (0.603)	12.44 (0.585)	0.393 (0.723)	3.656 (0.516)	11.847 (0.537)	1.385 (0.423)	5.934 (0.543)	13.42 (0.624)
	(0.5, 1)	2.091 (0.521)	6.6 (0.665)	11.719 (0.822)	1.013 (0.621)	3.61 (0.633)	12.143 (0.716)	2.227 (0.497)	5.738 (0.62)	14.864 (0.901)
	(1~)	2.348 (0.386)	6.071 (0.508)	11.276 (0.728)	0.88 (0.467)	3.398 (0.468)	11.244 (0.71)	1.703 (0.274)	4.898 (0.447)	13.992 (0.843)

The table reports herding behavior of each investor group in the actual nuclear threatening event period. Each column belongs to an investor group shows how the investor group behaves by firm size. The event period is comprised in the weeks of positive NYSE return. The herding behavior of each column is divided into 7 categories of 30 minute lagged return. Every number of the table is reported in percentage and every number in parenthesis is the standard deviation of the above number.

estimates when NYSE weekly returns are negative. Compared to the benchmark period, in the time intervals with negative previous return, herding behavior of all investor groups increases. In addition, institutes and foreigners herd more intensively than individuals. However, in panel B, there is no significant increase in herding behavior relative to the benchmark period. These are similar results to the results shown in positive feedback analysis. Only when NYSE weekly return is negative, investors seem to trade more collectively in response to the verbal threats from North Korea. It may be caused because the fear of investors builds up as Korea economy gets weaken and volatile due to low performance of NYSE index.

Herding activity on October 9th and 10th of the actual nuclear test day and the next day are represented in Table 7. We can see that the herding measures increase in all the classifications when the event occurred. In the time intervals with negative previous return, the increase in institutes' herding is much higher than that in the other investors while the increment of individuals' herding is notable in the positive lagged return part. Therefore, we can say that investors herd more as the intensity of nuclear threatening increases.

In estimation of herding behavior, we observe that investors herd more as the level of threat from North Korea increases. With the results in the positive feedback analysis, we can say that the market fluctuation around the nuclear test day shown in Figure 1 may be amplified by positive feedback trading of institutes and foreigners and raised herding behavior of all investors.

CONCLUSION

We study how investors react to the nuclear threats from North Korea. The reaction to the nuclear threats was significant, but those effects only lasted a few days. Therefore, we investigate it by very short time intervals. We examine investors' trading behavior in 30 minute time intervals. Also, we divide the nuclear threats into seven verbal threatening events and the one actual test. Then we compare the level of positive feedback trading and LSV herding when North Korea threatens the South with nuclear weapons with investors' trading activities during the relatively peaceful period.

Institutes and foreigners do positive feedback trading and individuals do contrarian trading in the benchmark period when there are no nuclear threats. This trading pattern held true when North Korea verbally threatened the South. Instead, positive feedback trading by institutes and foreigners and contrarian trading by individuals intensify over the benchmark period. However, when North Korea actually conducted a nuclear test, the trading tendency dependent on lagged returns almost disappeared. Individuals sold, whereas institutes and foreigners bought stocks. Institutes (individuals) still had positive (negative) slope to lagged return but foreigners buy regardless of previous returns. This may be caused by differences in risk evaluation for the nuclear threat among investor groups..

In benchmark time, the foreigners LSV herd measure is relatively higher than the others in big size firms. It can be interpreted as foreigners followed a fad in that period or, just did some collective trading. For the case of seven verbal threatening events, only when NYSE weekly return is negative, investors seem to herd more. It may be caused because the fear of investors builds up as Korea economy gets weaken and volatile due to low performance of NYSE index. On the other hand, when the actual nuclear test occurred, LSV herding measure increased in all investor groups regardless of NYSE weekly returns.

From the results shown in this paper, we can infer that the market fluctuation around the nuclear test day may be caused by heterogeneous belief about the impact of the nuclear threat among the three investor groups and by raised herding behavior of all investors. Moreover, institutions and foreigners' buying stocks around the actual nuclear threat seem to help the market becomes less destabilized. However, this paper does not find out whether heterogeneous belief or different risk evaluation about the threat among investor groups comes from information asymmetry or different risk attitude among the three investor groups. Further research on trading performance and changes in risk averseness of each investor group would clarify the impact of positive feedback trading and herding behavior in response to the North Korea nuclear threats on the market.

In the last decades, there are some places where military tensions have existed. A few of them have capital markets. For example, China vs Taiwan, Middle east vs Israel, Turkey vs Greece and North Korea vs South Korea. Thus we can observe the reaction of the investors in the capital markets when military event occurs. We hope that this thesis give some idea for other researches related to similar events.

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