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Article

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GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

Measuring the effect of the North Korea-U.S. summit on the South Korean stock market

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Additional information is available at the end of the article

Abstract: We examine the effects of the North Korea-U.S. summit and related events on the South Korean stock market over the period March 2018 to June 2018. Employing the event study methodology, we estimate sectoral abnormal returns following the events surrounding the summit and conduct several robustness tests to control for market integration and firm-specific information. Furthermore, we assess how sectoral systematic risk changes following these events by using various ARCH-type models such as GARCH, TARCH, EGARCH and PARCH. The results show that the South Korean stock market was highly sensitive to these events. In particular, we find that the market was negatively affected by the news that could reduce the probability of holding the summit and vice versa. We also find that market scepticism about the summit leads to the rise of a diamond risk structure.

Subjects: Risk Management for Events; International Finance; Public Finance; Corporate Finance

Keywords: North Korea-U.S. summit; abnormal returns; event study; systematic risk
JEL classifications: G1; G12; G14

1. Introduction

On 7 March 2018, Kim Jong Un, the North Korean leader, expressed his willingness to discuss the fate of his nuclear arsenal with the U.S. This announcement eventually led to a historic meeting between the North Korean leader and the U.S. President, Donald Trump. A successful meeting leading to the improvement of relations between North Korea and the U.S. could be perceived as reducing tension in the Korean Peninsula. However, the general perception, based on events from recent history, is that even if a deal was struck, it would not endure the test of time. Nevertheless, the exchange of smiles and handshakes during the summit created at least a transient feel-good factor for a more optimistic outlook.

ABOUT THE AUTHOR

We are an international research group consisting of members from Vietnam, United Arab Emirates and Australia. Our research activities cover several topics including political issues, environmental issues, banking regulations, financial regulations, cryptocurrency, blockchain and FinTech. This research paper is a part of our research series in the examination the relationship between political issues around the world and the stock markets.

PUBLIC INTEREST STATEMENT

The Trump-Kim summit is the historic political event in the modern world, and it brings various impacts on relevant parties. The road leading to this summit is rocky and South Korea plays a major role in facilitating this summit that can lead to a more stable Korea peninsula. Any events surrounding this summit may have an impact on South Korea. This paper examines the impact of the summit-related events on the South Korean stock market. Our study shows how the South Korean stock market is adversely affected by unfavourable news of the Summit.

Nuclear threat and potential military conflict in the Korean Peninsula have been present for many decades (Dibooglu & Cevikb, 2016; Haacke, 2013; Hughes, 1996; Kihl & Kim, 2005). As North Korea has gradually changed its attitude towards denuclearisation of the Korean Peninsula, an opportunity to eliminate a nuclear threat has been created. Since the South Korean government has become aware of North Korea's willingness to denuclearise, the South Korean leadership has worked tirelessly to coordinate the summit between the U.S. and North Korea. As this event was perceived to be conducive to a change in the entire political picture of the Korean Peninsula, it was expected to have a tremendous impact on the South Korea stock exchange.

Using the event study methodology, the purpose of the present study is to examine in some detail the extent to which the South Korean stock market was influenced by the summit and related events. In addition, we conduct several robustness tests to validate our findings, including those suggested by Corrado (1989) and by Chesney, Reshetar, and Karaman (2011), supplemented by the use of the Fama-French (2015) five-factor model, market integration, and the removal of firm-specific information. Since the events around the summit were also expected to affect sectoral systematic risks, we employ various ARCH models to examine the change in systematic risk of each sector in the South Korean market. In general, we find that the market was highly sensitive to the events around the summit. In particular, our results show that the stock market was negatively affected by events that could lead to an unsuccessful meeting between North Korea and the U.S. and positively affected by events that could lead to a successful meeting. We also find evidence for a diamond risk structure arising from scepticism about the summit.

The remainder of the paper is structured as follow. Section 2 presents a literature review on the financial impacts of political events, political uncertainty and North Korean issues. Section 3 describes the methodology used in this study. Section 4 discusses the empirical findings, whereas Section 5 elaborates on the selection of asset pricing models. Section 6 concludes the paper.

2. Literature review

2.1. Civil, military and political conflicts

The finance literature has addressed the financial consequences of civil, military and political conflicts. Some research applies the event study methodology, using firm-level data to capture the reaction of stock prices to conflicts (Abadie & Gardeazabal, 2003; Guidolin & La Ferrara, 2007). In addition, some literature examines financial indicators and investigates both the ex-ante and ex post effects associated with conflict. Rigobon and Sack (2005), for instance, investigated the response of US financial indicators to the risk of war with Iraq over the period from January 2003 to March 2003. They suggest that an increasing war risk is connected to lower stock, bond and commodity prices. This result is consistent with the findings of Leigh, Wolfers, and Zitzewitz (2003) and Wolfers and Zitzewitz (2009). Furthermore, Schneider and Troeger (2006) evaluate the reaction of stock market indices (including the Dow Jones, CAC and FTSE) during the military conflicts in Yugoslavia, Israel and Iraq from 1990 to 2000 and find that financial markets are affected adversely by the conflicts.

On the other hand, Amihud and Wohl (2004) find that a speedy end to war leads to an increase in stock prices and lower oil prices. Guidolin and La Ferrara (2010) use the event study methodology to examine the effect of 101 domestic and international military conflicts on capital markets, commodity prices and exchange rates between 1974 and 2004 and find mixed reactions to military conflicts in Asia and the Middle East.

2.2. Terrorist events

Another strand of the literature deals with terrorist events. Chen and Siems (2004), for example, examine the financial consequences of 14 terrorist attacks and conclude that stock markets (such as those of the U.S., U.K., France, Belgium, Sweden, Australia and Indonesia) tend to react negatively to these events. Likewise, Richman, Santos, and Barkoulas (2005) find that 28 stock

markets experienced statistically significant negative reactions to the 11 September 2001 event. Moreover, Baros and Gil-Alana (2009) document the negative effects of violence in the Basque Country on financial and economic activity, pointing out that stock returns declined due to violence. The negative impact of terrorist activities on stock markets is also documented in Asia-Pacific countries such as Malaysia, Indonesia, Singapore, Japan and Australia (Graham & Ramiah, 2012; Ramiah, 2012; Ramiah, Cam, Calabro, Maher, & Ghafouri, 2010; Ramiah & Hui, 2015).

Emerging literature related to the effect of terrorism risk on equity markets has a tendency to fit interaction variables into asset pricing models, including the CAPM or implement ARCH-type models to identify changes in systematic risk (Apergis & Arpergis, 2016; Aslam & Kang, 2015; Ramiah & Graham, 2013). While most studies indicate that risk intensifies following terrorist events, Graham and Ramiah (2012) suggest that following the 11 September attacks, financial markets did not react to terrorism since market participants have already incorporated the risk of terrorism into their expectations. A recent paper shows that terrorist activities affect the commodity markets 120 business days later (Ramiah, Wallace, Veron, Reddy, & Elliott, 2018)

2.3. North korea and political uncertainty

Hughes (1996) notes that North Korea represents a serious security matter, as it combines two extremely volatile issues: nuclear proliferation and conflict in the Korean Peninsula. In the last two decades, North Korea's nuclear program has been the main source of political instability and the most critical security matter in Northeast Asia (Haacke, 2013). Apart from being one of the most reclusive countries worldwide, North Korea has displayed a random, unpredictable and even impulsive reputation, which provides somewhat grave signals of potential international conflict and even a nuclear war (Dibooglu & Cevikb, 2016). Kihl and Kim (2005) argue that neither political repression nor economic poverty represent major concerns about North Korea, pointing out that the country represents a significant international security risk due to its nuclear capability and ballistic missile program.

The nuclear threat and military conflict in the Korean peninsula may affect financial markets in various magnitudes. However, all relevant parties such as North Korea, South Korea and the U.S. have substantial motives to avoid an unnecessary war. North Korean, for instance, is forced to restructure the county's economic priorities by reallocating resources due to corruption and economic mismanagement as nuclear arms can no longer guarantee the regime survival (Funabashi, 2007). According to Dibooglu and Cevikb (2016), a potential solution would be the integration of the North Korean economy into the global economy that will potentially eliminate the nuclear threat, leading to regional financial stability. Although a military conflict appears to be unlikely in the short run, the threat remains serious in the medium and long run unless North Korea agrees to denuclearise and dismantle its nuclear weapon system. This threat poses a high level of political uncertainty that may have an adverse effect on the stock market.

The existing literature documents evidence showing that risk and return in financial markets are affected by political uncertainty. Pham et al. (2018b) examine the impact of the 2016 U.S. presidential election on the U.S. stock market and find that the election widely affected the U.S. stock market. They also suggest that the U.S. stock market was highly responsive when Trump secured his Republican nomination. Another study by Bouoiyour and Selmi (2017) shows that Trump's victory had a negative impact on the event date and a positive effect during the post-election period by gathering the responses of eight large firms in the Dow Jones, S&P500 and Nasdaq indices. In addition, Ramiah, Pham, and Moosa (2017) examine the effect of Brexit on various sectors of the British economy in 2016, demonstrating that Brexit has a mixed effect on various sectors. In addition, Hira (2017) investigates the relationship between political instability and stock prices in Pakistan and reveals a negative relation between prices and political instability. Another study by Savita and Ramesh (2015) analyses the behaviour of stock prices during the 2014 Indian general elections using the event study methodology. They find highly positive cumulative

abnormal returns over different event windows and conclude that the market reacts positively to the possibility of a change in the government.

2.4. South korea and political threats

The research on the effects of North Korean threat on South Korean financial markets is rather limited and most studies use event or scenario-based analysis. Noland (2007), for instance, implements scenario analysis to investigate the economic implications of North Korea's nuclear program on Northeast Asian countries and indicates that South Korea is the most economically vulnerable to this program due to its geographic proximity.

Most recently, Huh and Pyun (2018) investigate investors' reaction to the North Korean nuclear tests by evaluating the performance of the financial market. They use a time-varying structural vector autoregression model to point out that investors' attention to nuclear threats has heterogeneous impacts on the stock prices of South Korean firms. Earlier, Dibooglu and Cevikb (2016) study the impact of the North Korean threat on financial markets in Japan and South Korea and attempt to find out whether the threat affects stock prices, interest rates and exchange rates. Their results show a causal relationship between the North Korean threat and stock returns and exchange rate returns in both countries. These results are inconsistent with the findings of Kim and Roland (2014) who use the event study methodology to evaluate the impact of North Korea's nuclear threat on South Korea's financial markets, examining 26 events associated with the North Korean nuclear threat from 2000 to 2008. They do not find statistically significant effects of the nuclear threat on financial markets and conclude that South Korea's financial markets do not perceive the nuclear threat as credible.

In general, the threat from North Korea potentially leads to declining asset prices, investment reductions and capital outflows in the financial markets of the targeted countries (Dibooglu & Cevikb, 2016). The literature, however, fails to address the issue of how the South Korean stock market responded to the North Korea-U.S. summit. South Korea plays an important role in facilitating the summit and it was expected to reduce the political risk in the Korea peninsula. These observations motivate us to investigate how the South Korean market reacted to summit-related events in terms of risk and return.

3. Methodology

3.1. Abnormal return and cumulative abnormal return estimation

Following Ramiah et al. (2017) and Pham et al. (2018b), we use the event study methodology to examine the effects of the North Korea-U.S. summit on the stock market—these effects are expressed in terms of sectoral abnormal returns. We hypothesise that the sectors experience negative abnormal returns if they perceive bad news (i.e. a decrease in the likelihood of the summit) that creates uncertainty for the stock market. On the other hand, we expect the sectors to have positive abnormal returns if they perceive the news as favourable to those sectors. If the news does not affect the sectors, no abnormal returns should be generated.

We first calculate daily returns, DR_{it}, and expected daily returns, $E(DR_{it})$, for every firm using the following equations:

$$DR_{it} = \ln\left(\frac{PI_{it}}{PI_{it-1}}\right) \tag{1}$$

$$E(DR_{it}) = \beta_{it}^{0} + \beta_{it}^{1}(r_{mkt} - r_f) \tag{2}$$

where PI_{it} is the stock price of firm i at time t, β_{it}^{0} and β_{it}^{1} are the intercept and the slope of the CAPM model respectively, r_{mkt} is the market index as proxied by KOSPI and r_f is the risk-free rate as proxied by 10-year bond yield.

Abnormal returns are estimated as follows:

$$DAR_{it} = DR_{it} - E(DR_{it}) \tag{3}$$

where DAR_{it} is the daily abnormal return of firm i at time t. The daily abnormal returns of all firms within a sector are averaged to estimate daily abnormal returns of sector s at time t, DAR_{st}. The t-statistic is used to check if a reaction is statistically significant for each announcement.

The efficient market hypothesis (EMH) does not always hold in the current market settings, making it necessary to perform additional estimations to check the presence or otherwise of continuing market reactions as represented by cumulative abnormal returns (CAR) 2, 5 and 10 days after the event date and, 2 and 5 days before the event date. The equations required for these estimations are as follow:

$$CAR(2)_{st} = \sum_{n=1}^{2} DAR_{st+n} \tag{4}$$

$$CAR(5)_{st} = \sum_{n=1}^{5} DAR_{st+n} \tag{5}$$

$$CAR(10)_{st} = \sum_{n=1}^{10} DAR_{st+n} \tag{6}$$

$$CAR(-5)_{st} = \sum_{n=1}^{5} DAR_{st-n} \tag{7}$$

$$CAR(-2)_{st} = \sum_{n=1}^{2} DAR_{st-n} \tag{8}$$

This exercise allows us to capture delayed reactions, continuing reactions or market anticipation following summit-related events. We also use the t-statistic to check if the results are statistically significant.

3.2. Robustness checks

It is often argued that the CAPM is obsolete and that a more advanced model is required to estimate expected returns (Fama & French, 1993, 2015). Therefore, we replace the CAPM as represented by Equation (2) by the Fama-French five-factor model to re-estimate expected returns and then re-calculate abnormal returns to check if the findings are consistent. The underlying objective is to control for more risk factors such as size (SMB), value (HML), profitability (RMW) and investment (CMA).[1] The model is specified as:

$$E(DR_{it}) = \beta_{it}^{0} + \beta_{it}^{1}(r_{mkt} - r_f) + \beta_{it}^{2}(SMB) + \beta_{it}^{3}(HML) + \beta_{it}^{4}(RMW) + \beta_{it}^{5}(CMA) + \varepsilon_{it} \tag{9}$$

In addition, we conduct several other robustness tests to control for the shortcomings of the event study methodology: (1) the Corrado (1989) non-parametric ranking test to control for non-normality of the abnormal return distribution; (2) removing firms that release firm-specific information within a window of ± 15 days from the event date to control for firm-specific effects; (3) the non-parametric conditional distribution approach proposed by Chesney et al. (2011) to estimate the probability of an event having an extreme effect on a sector; and (4) modifying the CAPM by incorporating three market risk premia representing Asia $\left(\tilde{r}_{mt}^{Asia} - \tilde{r}_{ft}^{Asia}\right)$, Europe $\left(\tilde{r}_{mt}^{Europe} - \tilde{r}_{ft}^{Europe}\right)$ and the U.S. $\left(\tilde{r}_{mt}^{US} - \tilde{r}_{ft}^{US}\right)$ into the model.

3.3. Systematic risk

Many studies have examined the effects of news on systematic risk (Engelberg, McLean, & Pontiff, 2018; Pham, Ramiah, Moosa, & Moyan, 2018a; Ramiah, Martin, & Moosa, 2013). Engelberg et al. (2018), for instance, show that betas are higher on earnings announcement days. Furthermore, Ramiah et al. (2013) find that regulatory announcements (such as environmental policy) could lead to various changes in systematic risk. A strand of this literature is about the effects of political events on systematic risk. Several studies have investigated this issue and found that systematic risk is heavily affected by major political events. Ramiah et al. (2017), for instance, reveals that the

Brexit referendum results led to an increase in "immediate risk". A recent study by Pham et al. (2018b) shows that many sectors in the U.S. experienced a surge in short-term systematic risk during the 2016 U.S. Presidential election.

Since March 2018, South Korea has played a major role in coordinating the historic meeting between North Korea and the U.S., which eventually took place on 12 June 2018. Although South Korea has close ties with the U.S., the country has faced a war threat from North Korea for many years. Therefore, a successful meeting between North Korea and the U.S. was expected to bring many benefits to South Korea such as a reduction in political risk in the Korea Peninsula that in turn would reduce the systematic risk of the South Korean stock market. Conversely, a failed meeting would lead to a surge in political risk and subsequently in the systematic risk of the market. In this study, we are going to capture both the aggregate and individual effects of the events surrounding the summit on systematic risk at the sectoral level. First, we create an aggregate dummy variable (D_{Summit}), which takes a value of 1 on the event date and 0 otherwise. We then incorporate this aggregate dummy variable to the CAPM and the modified model is as follow:

$$\tilde{r}_{St} - \tilde{r}_{ft} = \beta_S^0 + \beta_S^1\left[\tilde{r}_{mt} - \tilde{r}_{ft}\right] + \beta_S^2\left[\tilde{r}_{mt} - \tilde{r}_{ft}\right] * D_{Summit,t} + \beta_S^3 * D_{Summit,t} + \tilde{\varepsilon}_{St} \tag{10}$$

where $\tilde{r}_{St}$ is the return of sector S at time t,$\tilde{r}_{ft}$ is the risk-free rate at time t, $\tilde{r}_{mt}$ is the market return at time t, $D_{Summit,t}$ is the aggregate dummy variable, $\tilde{\varepsilon}_{St}$ is the error term, β_S^0 is the intercept of the regression equation where $E(\beta_S^0)$ is equal to zero, β_S^1 is the average short-term systematic risk of sector S, β_S^2 captures the change in the sectoral risk, and β_S^3 measures the change in the intercept of Equation (10).

The Chow test is conducted to detect the presence of structural breaks following summit-related events, while the Wald test is used to check for redundant variables. In addition, we introduce appropriate AR and MA terms to control for autocorrelation. Lastly, we use various GARCH specifications (such as GARH, TARCH, EGARCH and PARCH) to deal with the ARCH effects.

The problem with Equation (10) is that each event might have individual effects on systematic risk, which means that a different risk model is required to capture these individual effects. We create an individual dummy variable (*ID*) for each event and modify Equation (10) to estimate the individual short-term change in systematic risk. The model takes the form

$$\tilde{r}_{St} - \tilde{r}_{ft} = \beta_S^0 + \beta_S^1\left[\tilde{r}_{mt} - \tilde{r}_{ft}\right] + \sum_{j=1}^{15}\beta_{S,j}^{j+1}\left[\tilde{r}_{mt} - \tilde{r}_{ft}\right] * ID_j + \tilde{\varepsilon}_{St} \tag{11}$$

where ID_j is the individual dummy variable that takes a value of 1 on event j and zero otherwise, $\beta_{S,j}^{j+1}$ captures the change in systematic risk of sector S following event j. Since the summit might change the political situation in the Korean Peninsula in the long run, we expect the events to have a certain degree of impact on long-term systematic risk. The following model is used to capture the effects on long-term systematic risk:

$$\tilde{r}_{St} - \tilde{r}_{ft} = \beta_S^0 + \beta_S^1\left[\tilde{r}_{mt} - \tilde{r}_{ft}\right] + \sum_{j=1}^{15}\beta_{S,j}^{j+1}\left[\tilde{r}_{mt} - \tilde{r}_{ft}\right] * LD_j + \tilde{\varepsilon}_{St} \tag{12}$$

where LD_j takes the value of 1 from the event date and zero before the event date.

4. Data and empirical results

4.1. Data

The data, covering the period between June 2015 to August 2018, were downloaded from Thomson Reuter Eikon Datastream, including individual stock prices of all listed firms on the South Korean stock market. We use KOSPI as a proxy for market return and the 10-year Korea bond yield as a proxy for the risk-free rate. Daily factors for the Fama-French five-factor model

were downloaded from Kenneth French data library at Dartmouth College.[2] We collect firm-specific announcements from the Korean stock exchange. The announcements around the North Korea-U.S. summit were collected from various sources (see Table 1).[3,4]

4.2. Empirical results

In general, we observe that the summit tended to affect the South Korean stock market negatively and that the effect is widespread across sectors. We find 17 sectors experiencing negative abnormal returns following summit-related events (Table 2). The mining sector, for instance, exhibited an abnormal return of −7.03% (with a t statistic of −2.26) on 16 May 2018 when North Korea cancelled the talk with South Korea and threatened to cancel the summit.

On the other hand, the results show that few sectors reacted positively to the events around the summit (Table 3). The general retailers sector, for example, had a positive abnormal return of 1.92% (with a t statistic of 2.69) on 9 March 2018 when President Trump accepted the North Korean leader's invitation to meet at the summit. Another sector that experienced a positive abnormal return is the tobacco sector, which experienced an abnormal return of 4.47% (with a t-statistic of 3.27) on 10 May 2018 when President Trump announced that he would meet Kim Jong-Un on 12 June 2018 to discuss the denuclearisation of the Korean peninsula.

Furthermore, we find 14 sectors exhibiting mixed reactions following the events (Table 4). Although these sectors reacted both positively and negatively to the events, the magnitude of negative reactions tended to outweigh the magnitude of positive reactions in most sectors. For instance, the industrial metals and the mining sector reacted positively to event 8 (2.59% with a t statistic of 2.12), when President Trump announced that he would meet with the North Korean leader and event 9 (2.84% with a t statistic of 2.33) when North Korea uncovered a plan to dismantle its nuclear test site. The sector treated the two events as good news as they aimed to bring peace to the Korean Peninsula, hence reacting positively to both events. However, when the summit was threatened to be cancelled (events 10 and 13), the sector experienced negative abnormal returns of −7.96% (with a t statistic of −6.53) and −6.82% (with a t statistic of −5.50) on event 10 and event 13, respectively. This is an example of a sector that exhibited mixed reactions following the events around the summit where negative reactions outweigh positive reactions. Overall, our findings are consistent with those of Huh and Pyun (2018) whereby we find that the effects of the Trump-Kim summit on the South Korean stock market vary across the sectors. Furthermore, the effects are dependent on the possibility of the summit in which the South Korean stock market tends to positively (negatively) react to events that increase (decrease) the likelihood of the summit.

4.3. Negative reactions to the uncertainty of the summit

The long-awaiting meeting between the U.S. and North Korean leaders took a massive hit on 16 May 2018 (event 10) when North Korea cancelled talks with South Korea and threatened to cancel the summit. We observe that the uncertainty of the summit yielded negative abnormal returns as 21 sectors reacted negatively to event 10 and event 13 (Figure 1). Following event 10, the three sectors recording the highest negative abnormal returns were construction and materials, industrial metals and mining, and mining (Table 5). Construction and materials, for instance, had a negative abnormal return of −6.48% (with a t statistic of −4.71) and four out of five of the robustness tests (with an exception of Chesney test) support this finding (Table 7). In addition, the industrial metals and mining sector experienced the highest negative abnormal return (−7.96% with a t statistic of −6.53) following event 10, a result that is supported by all of the robustness tests.

On 25 May 2018 (event 13), a day after Trump announced the cancellation of the summit, North Korea declared its willingness to discuss the matter. However, investors were still overwhelmed by the announcement and did not treat it as good news. Twenty-one sectors experienced negative reactions following the event (Table 6). The results show that the industrial metals and mining

Table 1. Events around the North Korea-U.S. summit

Event	Date	Description
1	7/03/2018	After visiting Kim in Pyongyang, Chung Eui-yong, the South Korean presidential national security director, says the North Korean leader is willing to discuss the fate of his nuclear arsenal with the US.
2	9/03/2018	Trump accepts Kim's invitation to meet following a conversation with Moon's envoys.
3	27/03/2018	Kim makes a surprise visit to Beijing for a meeting with Chinese President Xi Jinping in an apparent move to strengthen his leverage in advance of his negotiations with Trump.
4	18/04/2018	Trump confirms that Mike Pompeo, then the CIA chief, had met secretly with Kim in North Korea and said "a good relationship was formed" heading into the adversaries' anticipated summit.
5	27/04/2018	Kim holds a summit meeting with Moon. The leaders announce aspirational goals of a nuclear-free peninsula and permanent peace.
6	7/05/2018	Kim makes the second visit to China to meet President Xi.
7	9/05/2018	Secretary of State Mike Pompeo travels to North Korea to meet Kim in preparation for the US-North Korean summit. North Korea releases three American detainees as a goodwill gesture ahead of a possible summit between Trump and Kim.
8	10/05/2018	President Trump announces he will meet Kim Jong-un on June 12 in Singapore to discuss the denuclearisation of the Korean peninsula.
9	12/05/2018	North Korea says it will hold a ceremony to dismantle its nuclear test site between May 23 and 25 and foreign journalists will be invited to attend.
10	16/05/2018	North Korea cancels talks with South Korea scheduled for the next day and threatened to cancel the Trump-Kim summit, citing discontent with US-South Korean joint military drills.
11	22/05/2018	Trump and Moon meet at the White House and express optimism for a successful summit between Trump and Kim. Moon says the "fate and the future of the Korean Peninsula hinge" on the meeting in Singapore.
12	24/05/2018	North Korea reports that it destroyed its nuclear testing site at Punggye-ri.
		In a letter to Kim, Trump cancels the US-North Korean summit scheduled for June 12, citing "tremendous anger and hostility" displayed by Pyongyang.
13	25/05/2018	In response to Trump's letter, Kim Kye Gwan, North Korean first minister of foreign affairs, states that North Korea "has the intent to sit with the US side regardless of ways at any time".
14	1/06/2018	President Trump takes a U-turn and confirms that he would meet Kim for a historic summit in Singapore on June 12 and that it will be the beginning of a "process."
15	12/06/2018	President Trump and North Korean leader Kim meet for a historic face-to-face summit.

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Table 2. Negative reactions following the events around the summit (in %)

Sector	Event	Date	AR	*t-stat*
Aerospace and Defense	1	7/03/2018	−3.07	*−2.47*
Automobiles and Parts	1	7/03/2018	−1.53	*−2.11*
	10	16/05/2018	−2.17	*−2.79*
	13	25/05/2018	−2.36	*−3.03*
Beverages	15	12/06/2018	−3.72	*−2.97*
Chemicals	10	16/05/2018	−3.14	*−4.45*
	13	25/05/2018	−2.11	*−2.96*
Electricity	10	16/05/2018	−2.84	*−2.15*
Electrical and Electronic Equipment	10	16/05/2018	−3.84	*−4.59*
	13	25/05/2018	−2.52	*−3.02*
Financial Services	1	7/03/2018	−1.87	*−2.53*
	10	16/05/2018	−1.88	*−2.48*
	13	25/05/2018	−1.73	*−2.27*
Forestry and Papers	10	16/05/2018	−3.98	*−3.66*
	13	25/05/2018	−2.67	*−2.45*
General Industrials	10	16/05/2018	−4.76	*−5.69*
	13	25/05/2018	−3.01	*−3.53*
Leisure Good	4	18/04/2018	−1.56	*−1.53*
	10	16/05/2018	−2.32	*−2.29*
Life Insurance	5	27/04/2018	−2.06	*−1.98*
	12	24/05/2018	−2.27	*−2.17*
Media	1	7/03/2018	−1.84	*−2.19*
	13	25/05/2018	−1.73	*−2.01*
Mining	10	16/05/2018	−7.03	*−2.26*
Personal Goods	2	9/03/2018	2.12	*2.38*
	10	16/05/2018	−2.54	*−2.76*
	13	25/05/2018	−2.60	*−2.87*
Real Estate Investment Trust	13	25/05/2018	−2.30	*−3.64*
Software and Computer Services	10	16/05/2018	−2.54	*−3.00*
	13	25/05/2018	−2.22	*−2.63*
Technology Hardware and Equipment Services	10	16/05/2018	−2.67	*−3.19*
	13	25/05/2018	−1.72	*−2.05*

Table 3. Positive reactions following the events around the summit (in %)

Sector	Event	Date	AR	*t-stat*
Equity Investment Instrument	3	27/03/2018	2.86	*2.04*
General Retailers	2	9/03/2018	1.92	*2.69*
HealthCare Equipment and Services	7	9/05/2018	3.78	*3.28*
Tobacco	8	10/05/2018	4.47	*3.27*

sector continued to take the biggest hit as it experienced an abnormal return of −6.82% (with a t statistic of −5.50), a result that is supported by all of the robustness tests (Table 8). We also find that the construction and materials sector had the second-highest negative abnormal return of

Table 4. Mixed reactions following the events around the summit (in %)

Sector	Event	Date	AR	*t-stat*
Alternative Energy	8	10/05/2018	3.27	*2.00*
	10	16/05/2018	−6.94	*−4.26*
Construction and Materials	2	9/03/2018	1.69	*2.45*
	9	14/05/2018	4.63	*3.36*
	10	16/05/2018	−6.48	*−4.71*
	13	25/05/2018	−6.70	*−4.74*
Food Producers	2	9/03/2018	1.53	*2.22*
	10	16/05/2018	−2.46	*−3.09*
	13	25/05/2018	−2.41	*−2.97*
Gas, Water and Multiutilities	9	14/05/2018	1.77	*2.80*
	13	25/05/2018	−1.11	*−2.12*
Household Equipment and Services	2	9/03/2018	1.99	*2.46*
	10	16/05/2018	−2.81	*−3.29*
	13	25/05/2018	−2.81	*−3.33*
Industrial Engineering	9	14/05/2018	2.46	*2.65*
	10	16/05/2018	−4.63	*−4.99*
	13	25/05/2018	−4.34	*−4.64*
Industrial Metals and Mining	8	10/05/2018	2.59	*2.12*
	9	14/05/2018	2.84	*2.33*
	10	16/05/2018	−7.96	*−6.53*
	13	25/05/2018	−6.82	*−5.50*
Industrial Transportation	8	10/05/2018	3.89	*4.12*
	9	14/05/2018	2.28	*2.33*
	10	16/05/2018	−4.44	*−4.51*
	13	25/05/2018	−3.62	*−3.63*
	15	12/06/2018	−2.11	*−2.03*
Mobile Telecommunications	1	7/03/2018	−3.45	*−2.16*
	8	10/05/2018	5.19	*3.05*
Oil and Gas Producers	4	18/04/2018	1.69	*2.16*
	9	14/05/2018	2.60	*2.88*
	10	16/05/2018	−3.02	*−3.38*
	13	25/05/2018	−3.59	*−3.96*
Personal Goods	2	9/03/2018	2.12	*2.38*
	10	16/05/2018	−2.54	*−2.76*
	13	25/05/2018	−2.60	*−2.87*
Pharmaceuticals and Biotechnology	4	18/04/2018	−3.95	*−2.86*
	7	9/05/2018	3.64	*2.61*
Support Services	10	16/05/2018	−2.96	*−3.65*
	13	25/05/2018	−3.54	*−4.31*
	14	1/06/2018	1.76	*2.07*
Travel and Leisure	2	9/03/2018	3.59	*3.94*
	13	25/05/2018	−3.00	*−3.01*

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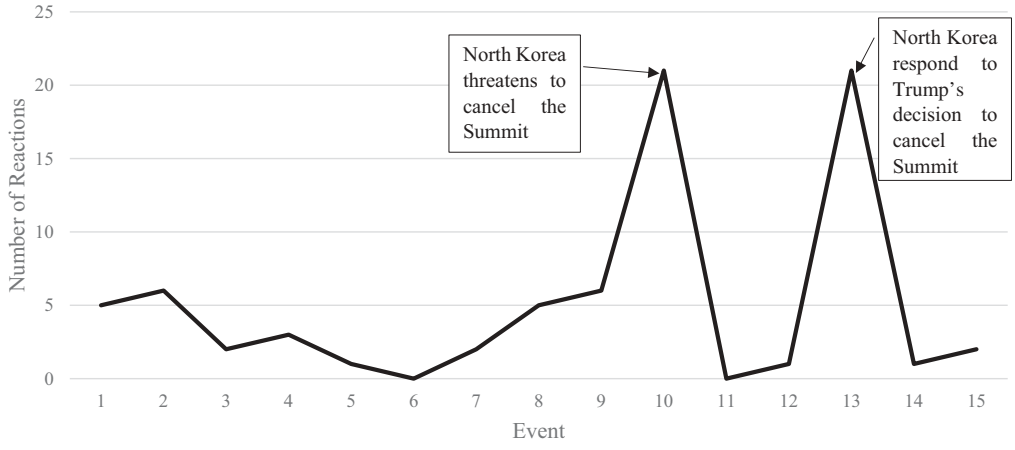
Figure 1. Number of sectoral reactions following each event around the summit.



−6.70% (with a t statistic of −4.74)—this again is a result that is supported by all of the robustness tests.

In addition, we estimate the cumulative abnormal returns of two and five days before events 10 and 13 to find out if the market anticipated the events. We find that the market did not anticipate the threat to cancel the summit from North Korea (event 10) as most sectors did not experience negative cumulative abnormal returns of two and five days before event 10 (Table 5). On the other hand, the results show that investors in certain sectors (including construction and materials, food producers, forestry and papers, general industrials, industrial metals and mining) were particularly pessimistic about the possibility of the summit as these sectors exhibited negative abnormal returns two days before event 13 (Table 6). Our results suggest that these reactions might be caused by the spillover effect from event 12 when Trump cancelled the summit via a letter to Kim. An interesting observation is that the South Korean market is more responsive to summit-related announcements originating from the U.S than those coming from its neighbour. Furthermore, we check if the reaction persisted by calculating the cumulative abnormal returns of two, five and ten days after the event day and find that all negative reactions following event 10 and 13 did not continue to the following days (Tables 5 and 6).

4.4. Systematic risk

The results show that the systematic risk of most sectors did not change in aggregate (Table 9). Mobile telecommunication is the only sector that experienced an increase in systematic risk on an aggregate basis (up from 0.57 to 2.07). We also document two sectors that exhibited a decline in systematic risk in aggregate, including construction and materials (down from 0.54 to −0.63) and industrial metals and mining (down from 0.52 to −0.34). When we use Equation (11) to estimate the individual effect of each announcement on systematic risk, we observe a diamond risk phenomenon over the period between when the North Korean leader expressed his willingness to discuss the fate of his nuclear arsenal with the U.S. and the acceptance by the U.S. president of the invitation from the North Korean leader (Figure 2). We find that most sectors experienced a surge in systematic risk (with the exceptions of three sectors including oil and gas, industrial metals and mining, and real estate investment trust) following event 1 when the news about the possibility of the summit broke out on 7 March 2018. Systematic risks reverted to their normal levels following event 2 on 9 March 2018. This phenomenon shows that the South Korean stock market was sceptical about the summit.

In addition, we replace the short-term individual dummy variables (*ID*) by the long-term individual dummy variables (*LD*) and estimate Equation (12) to examine the effects of the events surrounding the summit on long-term systematic risk. We find out that long-term systematic

Table 5. Sectoral reactions when North Korea threatens to cancel the summit on 16 May 2018 (in %)

Sector	CAR-2	*t-stat*	CAR-5	*t-stat*	AR	*t-stat*	CAR2	*t-stat*	CAR5	*t-stat*	CAR10	*t-stat*
Alternative Energy	3.15	*1.38*	3.54	*1.00*	−6.94	*−4.26*	0.05	*0.02*	−1.75	*−0.50*	−4.84	*−0.97*
Automobiles and Parts	1.08	*0.92*	3.83	*1.98*	−2.17	*−2.79*	3.53	*3.02*	2.81	*1.45*	0.00	*0.00*
Chemicals	0.61	*0.61*	2.99	*1.92*	−3.14	*−4.45*	2.20	*2.20*	1.32	*0.85*	0.21	*0.10*
Construction and Materials	5.80	*3.23*	8.49	*3.18*	−6.48	*−4.71*	2.35	*1.31*	−0.40	*−0.15*	0.08	*0.02*
Electricity	0.88	*0.47*	−2.93	*−1.12*	−2.84	*−2.15*	0.08	*0.04*	−1.01	*−0.39*	−1.94	*−0.57*
Electrical and Electronic Equipment	1.77	*1.42*	4.68	*2.34*	−3.84	*−4.59*	1.95	*1.56*	1.46	*0.73*	1.57	*0.58*
Financial Services	0.48	*0.43*	3.33	*1.84*	−1.88	*−2.48*	1.51	*1.35*	1.00	*0.55*	−0.13	*−0.05*
Food Producers	1.10	*0.94*	2.97	*1.58*	−2.46	*−3.09*	1.70	*1.45*	0.49	*0.26*	−0.91	*−0.34*
Forestry and Papers	1.33	*0.84*	4.50	*1.90*	−3.98	*−3.66*	5.68	*3.60*	6.59	*2.79*	4.75	*1.33*
General Industrials	1.77	*1.48*	4.00	*2.02*	−4.76	*−5.69*	1.27	*1.07*	1.18	*0.60*	−2.43	*−0.78*
Household Equipment and Services	0.96	*0.75*	1.61	*0.81*	−2.81	*−3.29*	2.45	*1.92*	1.61	*0.81*	0.41	*0.15*
Industrial Engineering	2.44	*1.77*	5.81	*2.71*	−4.63	*−4.99*	1.37	*0.99*	0.56	*0.26*	−0.42	*−0.15*
Industrial Metals and Mining	3.65	*2.28*	6.33	*2.52*	−7.96	*−6.53*	2.44	*1.52*	−0.55	*−0.22*	−2.74	*−0.73*
Industrial Transportation	3.31	*2.51*	8.12	*4.17*	−4.44	*−4.51*	1.47	*1.11*	−0.27	*−0.14*	−1.34	*−0.51*
Leisure Good	0.13	*0.09*	2.58	*1.07*	−2.32	*−2.29*	2.52	*1.73*	1.69	*0.71*	2.07	*0.65*
Mining	−0.18	*−0.04*	0.31	*0.04*	−7.03	*−2.26*	4.57	*1.02*	2.39	*0.34*	−3.74	*−0.38*
Oil and Gas Producers	3.00	*2.46*	4.35	*2.36*	−3.02	*−3.38*	3.92	*3.25*	4.55	*2.55*	2.84	*1.19*
Personal Goods	0.15	*0.11*	1.91	*0.90*	−2.54	*−2.76*	2.20	*1.68*	1.33	*0.63*	0.93	*0.30*
Software and Computer Services	−0.14	*−0.11*	3.05	*1.40*	−2.54	*−3.00*	1.89	*1.48*	0.82	*0.38*	1.80	*0.57*
Support Services	1.78	*1.51*	3.68	*1.83*	−2.96	*−3.65*	1.39	*1.17*	1.12	*0.56*	1.09	*0.37*
Technology Hardware and Equipment Services	−0.01	*−0.01*	3.05	*1.45*	−2.67	*−3.19*	2.36	*1.85*	2.00	*0.95*	2.61	*0.91*

Table 6. Sectoral reactions when North Korea responds to Trump's decision to cancel the summit on 25 May 2018 (in %)

Sector	CAR-2	*t-stat*	CAR-5	*t-stat*	AR	*t-stat*	CAR2	*t-stat*	CAR5	*t-stat*	CAR10	*t-stat*
Automobiles and Parts	−2.28	*−1.95*	−0.13	*−0.07*	−2.36	*−3.03*	1.08	*0.91*	0.53	*0.27*	3.02	*1.12*
Chemicals	−1.20	*−1.20*	−0.01	*−0.01*	−2.11	*−2.96*	1.34	*1.30*	1.99	*1.25*	2.92	*1.39*
Construction and Materials	−3.98	*−2.18*	−4.64	*−1.71*	−6.70	*−4.74*	8.94	*4.85*	9.01	*3.19*	5.61	*1.33*
Electrical and Electronic Equipment	−1.08	*−0.86*	0.13	*0.07*	−2.52	*−3.02*	2.61	*2.05*	3.00	*1.46*	4.30	*1.53*
Financial Services	−1.12	*−1.00*	−0.30	*−0.17*	−1.73	*−2.27*	0.68	*0.59*	0.06	*0.03*	0.57	*0.21*
Food Producers	−2.55	*−2.17*	−1.31	*−0.69*	−2.41	*−2.97*	1.75	*1.47*	4.01	*2.08*	5.84	*2.12*
Forestry and Papers	−3.35	*−2.12*	3.78	*1.59*	−2.67	*−2.45*	1.08	*0.68*	3.07	*1.26*	1.20	*0.33*
Gas, Water and Multiutilities	0.41	*0.56*	1.83	*1.47*	−1.11	*−2.12*	2.49	*3.47*	2.27	*1.84*	1.50	*0.76*
General Industrials	−2.37	*−1.98*	−1.20	*−0.61*	−3.01	*−3.53*	1.77	*1.44*	1.58	*0.76*	0.04	*0.01*
Household Equipment and Services	−1.43	*−1.13*	0.12	*0.06*	−2.81	*−3.33*	2.57	*1.97*	2.43	*1.16*	2.34	*0.80*
Industrial Engineering	−0.68	*−0.49*	−0.70	*−0.32*	−4.34	*−4.64*	2.38	*1.71*	1.61	*0.75*	3.12	*1.06*
Industrial Metals and Mining	−4.04	*−2.51*	−4.22	*−1.67*	−6.82	*−5.50*	6.34	*3.91*	7.55	*2.98*	8.24	*2.05*
Industrial Transportation	−2.12	*−1.58*	−2.06	*−1.03*	−3.62	*−3.63*	3.94	*2.92*	4.20	*2.07*	6.89	*2.49*
Media	−0.02	*−0.01*	1.63	*0.86*	−1.73	*−2.01*	2.96	*2.35*	3.14	*1.64*	3.61	*1.32*
Oil and Gas Producers	−0.82	*−0.68*	1.37	*0.77*	−3.59	*−3.96*	3.04	*2.50*	4.97	*2.75*	5.16	*2.11*
Personal Goods	−0.13	*−0.10*	1.94	*0.91*	−2.60	*−2.87*	1.28	*0.96*	2.47	*1.12*	2.71	*0.83*
Real Estate Investment Trust	−0.89	*−1.06*	−1.20	*−0.94*	−2.30	*−3.64*	0.97	*1.14*	0.28	*0.21*	1.36	*0.74*
Software and Computer Services	−0.50	*−0.40*	0.39	*0.18*	−2.22	*−2.63*	2.01	*1.57*	3.01	*1.37*	3.64	*1.15*
Support Services	−0.19	*−0.16*	0.52	*0.25*	−3.54	*−4.31*	3.18	*2.53*	5.85	*2.60*	5.82	*1.80*
Technology Hardware and Equipment Services	0.04	*0.03*	1.69	*0.80*	−1.72	*−2.05*	1.23	*0.94*	2.22	*1.03*	3.70	*1.25*
Travel and Leisure	−1.10	*−0.77*	−2.08	*−0.90*	−3.00	*−3.01*	2.47	*1.70*	3.78	*1.59*	2.64	*0.76*

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Table 7. Robustness tests for sectoral reactions on 16 May 2018

		Chesney		Market Integration		Firm-specific Removal		Fama French Five-Factor Model	
Sector	**tCorrado**	**CP**	***t-stat***	**AR(%)**	***t-stat***	**AR(%)**	***t-stat***	**AR(%)**	***t-stat***
Alternative Energy	−3.63	0.22	*0.83*	−6.78	*−4.18*	N/A	*N/A*	−6.02	*−3.59*
Automobiles and Parts	−2.59	0.25	*0.71*	−2.21	*−2.84*	−3.24	*−3.72*	−1.74	*−2.11*
Chemicals	−3.22	0.06	*1.90*	−3.29	*−4.67*	−3.69	*−4.89*	−2.55	*−3.05*
Construction and Materials	−3.26	0.30	*0.57*	−6.40	*−4.72*	−6.89	*−5.01*	−5.85	*−4.16*
Electricity	−2.34	0.41	*0.24*	−2.82	*−2.12*	−1.60	*−1.56*	−2.44	*−1.80*
Electrical and Electronic Equipment	−3.11	0.01	*3.29*	−3.82	*−4.59*	−3.80	*−4.19*	−3.03	*−3.17*
Financial Services	−2.02	0.46	*0.09*	−1.81	*−2.38*	−2.44	*−2.90*	−0.86	*−0.91*
Food Producers	−2.01	0.49	*0.01*	−2.60	*−3.26*	−2.37	*−3.01*	−2.11	*−2.46*
Forestry and Papers	−2.92	0.03	*2.54*	−4.16	*−3.87*	−5.71	*−5.40*	−3.58	*−3.21*
General Industrials	−3.49	0.19	*0.98*	−4.72	*−5.67*	−4.43	*−5.59*	−4.18	*−4.67*
Household Equipment and Services	−2.47	0.08	*1.69*	−3.13	*−3.71*	−1.30	*−1.31*	−2.65	*−3.01*
Industrial Engineering	−3.55	0.01	*3.03*	−4.55	*−4.97*	−4.85	*−4.95*	−3.86	*−3.82*
Industrial Metals and Mining	−3.69	0.02	*2.91*	−7.89	*−6.52*	−8.72	*−7.39*	−7.30	*−5.75*
Industrial Transportation	−2.94	0.06	*1.86*	−4.34	*−4.47*	−4.80	*−3.82*	−3.91	*−3.71*
Leisure Good	−1.91	0.01	*3.99*	−2.36	*−2.30*	−2.79	*−2.52*	−1.33	*−1.14*
Mining	−2.07	0.02	*2.89*	−7.32	*−2.35*	−4.98	*−1.10*	−6.01	*−1.89*
Oil and Gas Producers	−1.79	0.15	*1.16*	−2.92	*−3.30*	−4.95	*−4.31*	−2.60	*−2.77*
Personal Goods	−2.12	0.02	*2.65*	−2.36	*−2.63*	−2.61	*−3.12*	−1.95	*−2.04*
Software and Computer Services	−2.39	0.05	*1.99*	−2.43	*−3.06*	−2.00	*−2.18*	−1.60	*−1.72*
Support Services	−2.56	0.05	*1.96*	−2.91	*−3.62*	−1.92	*−1.99*	−2.39	*−2.71*
Technology Hardware and Equipment Services	−2.91	0.27	*0.65*	−2.70	*−3.26*	−3.09	*−3.52*	−1.75	*−1.78*

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Table 8. Robustness tests for sectoral reactions on 25 May 2018

25/05/2018		Chesney		Market Integration		Firm-specific Removal		Fama French Five-Factor Model	
Sector	**tCorrado**	**CP**	***t-stat***	**AR(%)**	***t-stat***	**AR(%)**	**t-stat**	**AR(%)**	***t-stat***
Automobiles and Parts	−2.99	0.06	*1.86*	−2.34	*−3.01*	−2.31	*−2.93*	−2.36	*−2.85*
Chemicals	−2.73	0.02	*2.92*	−2.07	*−2.92*	−2.28	*−3.14*	−2.05	*−2.42*
Construction and Materials	−3.34	0.01	*3.19*	−6.50	*−4.66*	−5.55	*−4.21*	−6.60	*−4.56*
Electrical and Electronic Equipment	−2.32	0.22	*0.83*	−2.51	*−3.02*	−2.74	*−3.10*	−2.53	*−2.64*
Financial Services	−2.46	0.04	*2.21*	−1.60	*−2.11*	−2.66	*−2.99*	−1.71	*−1.81*
Food Producers	−2.60	0.39	*0.28*	−2.39	*−2.93*	−2.48	*−2.95*	−2.53	*−2.87*
Forestry and Papers	−2.70	0.31	*0.53*	−2.62	*−2.43*	−2.92	*−2.46*	−2.70	*−2.41*
Gas, Water and Multiutilities	−1.96	0.24	*0.75*	−1.07	*−2.11*	−0.63	*−1.16*	−1.11	*−2.08*
General Industrials	−2.96	0.34	*0.43*	−2.92	*−3.44*	−2.79	*−2.98*	−2.97	*−3.24*
Household Equipment and Services	−2.33	0.03	*2.31*	−2.89	*−3.44*	−2.32	*−2.54*	−2.93	*−3.36*
Industrial Engineering	−3.01	0.03	*2.48*	−4.13	*−4.48*	−3.50	*−3.61*	−4.24	*−4.14*
Industrial Metals and Mining	−3.39	0.01	*3.46*	−6.71	*−5.45*	−4.67	*−4.08*	−6.80	*−5.24*
Industrial Transportation	−3.38	0.02	*2.95*	−3.47	*−3.52*	−4.70	*−3.55*	−3.57	*−3.33*
Media	−2.05	0.02	*2.44*	−1.61	*−1.91*	−1.75	*−2.14*	−1.76	*−1.90*
Oil and Gas Producers	−1.61	0.02	*2.72*	−3.48	*−3.87*	−8.31	*−5.29*	−3.54	*−3.68*
Personal Goods	−2.51	0.01	*3.69*	−2.68	*−3.04*	−2.69	*−3.14*	−2.84	*−3.02*
Real Estate Investment Trust	−3.45	0.01	*3.23*	−2.30	*−3.45*	−2.37	*−3.34*	−2.22	*−3.29*
Software and Computer Services	−2.42	0.05	*2.07*	−1.90	*−2.40*	−2.03	*−2.17*	−2.01	*−2.16*
Support Services	−2.82	0.39	*0.30*	−3.46	*−4.24*	−1.71	*−1.91*	−3.52	*−3.92*
Technology Hardware and Equipment Services	−2.21	0.06	*1.88*	−1.69	*−2.03*	−1.90	*−2.19*	−1.70	*−1.73*
Travel and Leisure	−2.65	0.15	*1.17*	−2.96	*−2.99*	−2.87	*−1.67*	−3.13	*−2.96*

Table 9. Aggregate change in systematic risk following the announcements around the summit

				Aggregate Change in Beta				
Sector	**Intercept**	**Change in Intercept**	**Beta**	**GARCH (1,1)**	**OLS**	**TARCH**	**EGARCH**	**PARCH**
Construction and Materials	0.00	0.00	0.54	−1.17	−0.79	−1.26	−1.28	3.08
t-stat	*0.31*	*1.26*	*76.68*	*−6.10*	*−1.55*	*−6.67*	*−6.95*	*9.63*
Industrial Metals and Mining	0.00	0.00	0.52	−0.86	−0.29	1.90	−1.11	−0.91
t-stat	*1.17*	*−0.99*	*76.58*	*−3.11*	*−0.59*	*10.66*	*−3.59*	*−3.40*
Mobile Telecommunications	0.00	−0.01	0.57	1.55	1.08	1.55	1.60	1.58
t-stat	*−1.10*	*−2.12*	*45.97*	*3.47*	*1.44*	*3.46*	*3.69*	*3.59*

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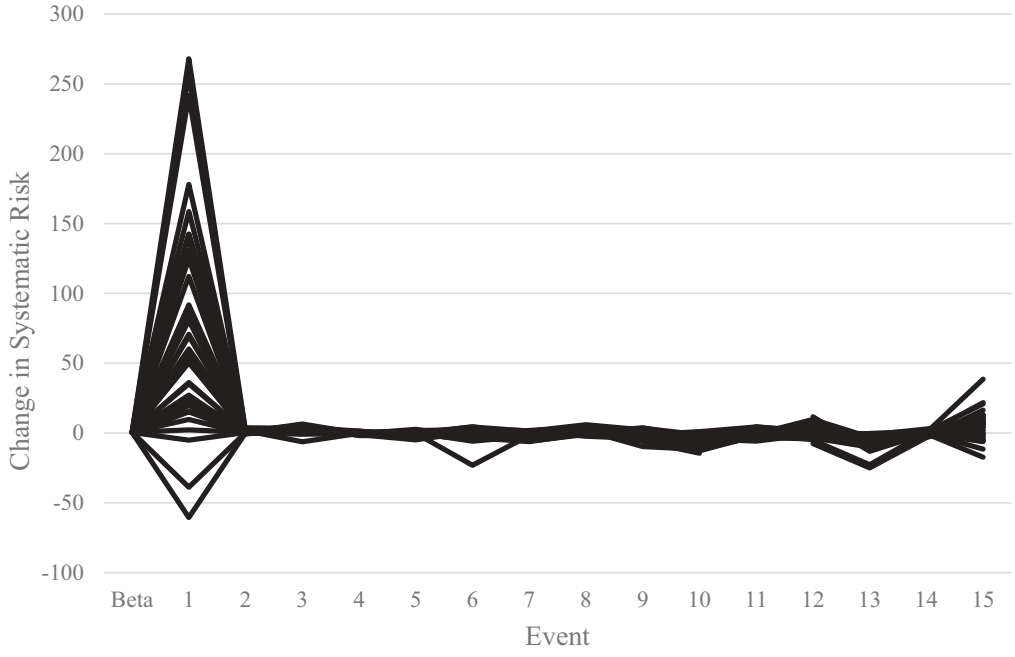

Figure 2. Short-term change in systematic risk following the events around the summit.

risk was fluctuating heavily from event 6 to event 8 when North Korea and the U.S. were preparing for the summit and when President Trump announced officially the date of the summit in Singapore (Figure 3). Furthermore, we find a lower degree of diamond risk structure between event 12 and 13 when President Trump cancelled the summit.

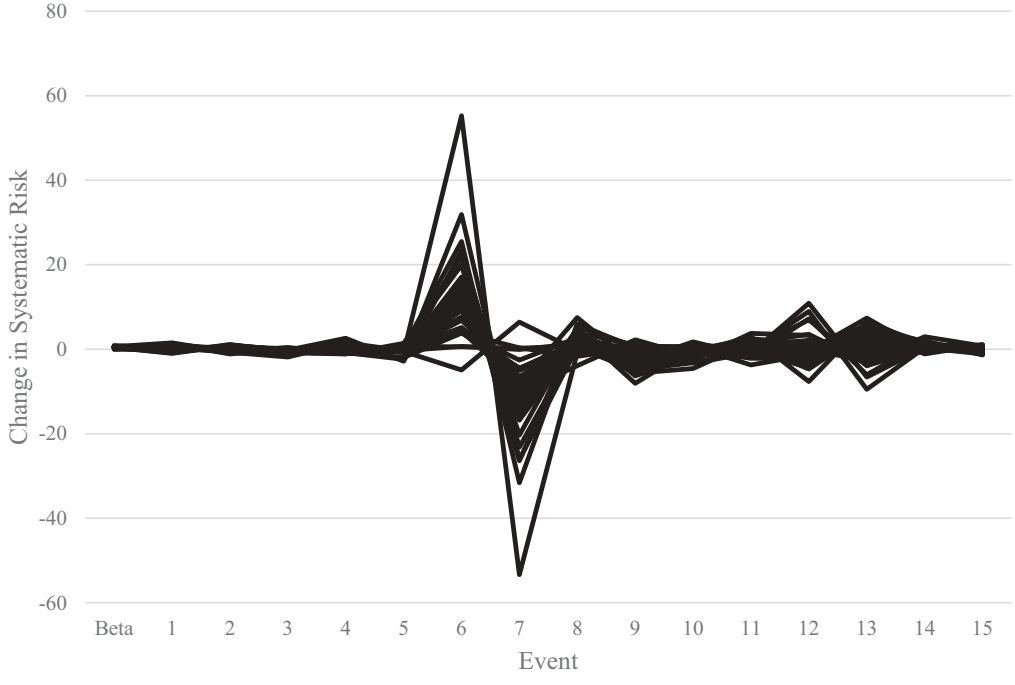

Figure 3. Long-term changes in systematic risk following the events around the summit.

5. Extensions

It is always difficult to select an appropriate asset pricing model to estimate expected returns, which is why researchers tend to use as many models as they can. In this section, we discuss some empirical evidence on the use of different asset pricing models and their variation to estimate expected returns. The models include the CAPM (model 1), the modified CAPM controlling for different market spillover effects (model 2), and the Fama-French five-factor model (model 3). The results show that a more advanced asset pricing model (for example, controlling for more risk factors) occasionally over-estimates expected returns (in comparison to the CAPM). We use the evidence of abnormal returns on 16 May 2018 and 25 May 2018 as these two events produced the highest number of reactions.

Since daily returns do not vary across the models, the difference in abnormal returns is, in fact, similar to the difference in expected returns as captured by the three models. Table 10 reports the percentage differences in abnormal returns among the three asset pricing models on 16 May 2018 whereby D12 shows the difference in abnormal returns between model 1 and model 2, D13 indicates the difference in abnormal returns between model 1 and model 3, and D23 displays the difference in abnormal returns between model 2 and model 3. We find that using model 2 (controlling for risk premiums from various markets) occasionally over-estimates expected returns

Table 10. Difference in abnormal returns using various asset pricing models on 16 May 2018

Sector	D12	D13	D23
Alternative Energy	−2.24%	−13.27%	−11.28%
Automobiles and Parts	1.81%	−19.69%	−21.12%
Chemicals	4.63%	−18.64%	−22.24%
Construction and Materials	−1.21%	−9.77%	−8.66%
Electricity	−0.79%	−14.24%	−13.56%
Electrical and Electronic Equipment	−0.39%	−21.08%	−20.76%
Financial Services	−4.00%	−54.60%	−52.71%
Food Producers	5.63%	−14.44%	−19.00%
Forestry and Papers	4.57%	−10.07%	−14.00%
General Industrials	−0.87%	−12.23%	−11.46%
Household Equipment and Services	11.43%	−5.79%	−15.46%
Industrial Engineering	−1.87%	−16.66%	−15.07%
Industrial Metals and Mining	−0.93%	−8.29%	−7.43%
Industrial Transportation	−2.26%	−11.88%	−9.84%
Leisure Good	2.06%	−42.79%	−43.95%
Mining	4.13%	−14.50%	−17.89%
Oil and Gas Producers	−3.23%	−13.79%	−10.92%
Personal Goods	−7.02%	−22.98%	−17.17%
Software and Computer Services	−4.25%	−37.03%	−34.24%
Support Services	−1.83%	−19.31%	−17.80%
Technology Hardware and Equipment Services	1.46%	−34.20%	−35.14%
Average	0.23%	−19.77%	−19.99%
Max	11.43%	−5.79%	−7.43%
Min	−7.02%	−54.60%	−52.71%

Table 11. Difference in abnormal returns using various asset pricing models on 25 May 2018

Sector	D12	D13	D23
Automobiles and Parts	−0.79%	−0.23%	0.56%
Chemicals	−1.62%	−2.65%	−1.05%
Construction and Materials	−3.06%	−1.47%	1.64%
Electrical and Electronic Equipment	−0.59%	0.22%	0.81%
Financial Services	−7.02%	−0.73%	6.77%
Food Producers	−1.07%	4.78%	5.91%
Forestry and Papers	−1.65%	1.35%	3.05%
Gas, Water and Multiutilities	−3.30%	−0.13%	3.28%
General Industrials	−3.05%	−1.13%	1.97%
Household Equipment and Services	2.58%	4.17%	1.56%
Industrial Engineering	−4.81%	−2.36%	2.58%
Industrial Metals and Mining	−1.64%	−0.28%	1.39%
Industrial Transportation	−4.08%	−1.51%	2.68%
Media	−6.93%	1.38%	8.93%
Oil and Gas Producers	−3.21%	−1.54%	1.72%
Personal Goods	3.21%	9.40%	5.99%
Real Estate Investment Trust	0.29%	−3.26%	−3.54%
Software and Computer Services	−14.21%	−9.32%	5.71%
Support Services	−2.07%	−0.51%	1.59%
Technology Hardware and Equipment Services	−1.97%	−0.94%	1.05%
Travel and Leisure	−1.34%	4.41%	5.82%
Average	−2.68%	−0.02%	2.78%
Max	3.21%	9.40%	8.93%
Min	−14.21%	−9.32%	−3.54%

in several sectors in comparison to the CAPM (for example, household equipment and services). The results also show that the Fama-French five-factor model performs better than both the CAPM and the modified CAPM models in this scenario since using this model yields significantly lower expected returns for all 21 sectors. This finding is, however, not consistent with other events. We observe that CAPM might not be too obsolete in certain circumstances in comparison to other advanced models (Table 11) and expected returns, as estimated by model 2 and model 3 on 25 May 2018, are higher than what is produced by the CAPM in 3 and 7 sectors, respectively.

6. Conclusion

The North Korea-U.S. summit marked a historic political event that directly affected South Korea in many aspects since it has always striven for political stability in the Korean Peninsula, which would provide a better business environment for Korean firms. Our study examines how the South Korean stock market reacts to the summit-related events by using event methodology and various robustness tests. Our findings show that South Korean firms and investors were desperately looking forward to a successful meeting between North Korea and the U.S. since most negative reactions arose in response to events that led to uncertainty about the summit. Likewise, most positive reactions occurred following events

that were conducive to materialisation of the summit. We also find a diamond risk phenomenon in the South Korean stock market due to its scepticism about the summit. The contribution of our study to the literature is threefold. First, our study shows how each sector in South Korea responds to the summit-related events in terms of risk and return. In addition, we provide empirical evidence of the responsiveness of the South Korean market to announcements originated from the U.S. Finally, our study provides a comprehensive comparison on the performance of various asset pricing models used in event study. One of the limitations of event study is that it is difficult to differentiate the real effect of an event from noise. Our study attempts to resolve this issue by removing the firms releasing firm-specific information in the window of 15 days before and after the event day. However, the drawback of this methodology is that it also removes all the firms even if the firm-specific information might not have any impact on those firms. Developing such a methodology to resolve this issue is beyond the scope of this paper and we leave this question to future studies.

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Notes
1. For a detailed description of the five-factor model, see Fama and French (2015).
2. Accessed the following website on 20 August 2018: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.
3. Accessed the following website on 12 August 2018: https://www.thehindubusinessline.com/news/world/trump-kim-summit-a-timeline/article24142159.ece.
4. Accessed the following website on 12 August 2018: https://www.aljazeera.com/news/2018/06/timeline-donald-trump-kim-jong-singapore-summit-june-12-180601194017692.html.

correction
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