# The Impact of North Korea Threats on Stock Return Volatility

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We use media news reports concerning North Korea threats from 2016 to 2017 to measure the magnitude of geopolitical risk on the Korean Peninsula and analyze the impact of the geopolitical risk on the risk components of Korean stocks. Our result shows that the North Korea risk significantly increases the volatility of domestic stock returns, which is mainly attributable to an increase in systematic risk rather than unsystematic risk of the stocks. This finding remains robust when alternative measures of the systematic risk are used. The evidence in this study suggests that geopolitical risk on the Korean Peninsula is an important factor that can affect stock prices by increasing the systematic risk of stocks.

**Keywords:** North Korea threats, Geopolitical risk, Stock return volatility, Systematic risk, News reports

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## I. Introduction

The presence of North Korea is an inherent risk factor in the Korean capital markets. Since a ceasefire in the Korean War was called in 1953, North Korea has frequently made military provocations against South Korea and some of them have had the potential to lead to a full-scale war. Particularly over the past few years, North Korea has significantly escalated geopolitical tensions on the Korean Peninsula since Kim Jong-un became the leader of North Korea in April 2012. During this period, North Korea's military actions have intensified in frequency and strength. For example, Kim Jong-un conducted more ballistic missile launches and nuclear weapon tests between 2012 and 2017 than his predecessor, Kim Jung-il.[1] Due to this North Korea risk factor, Korean stocks tend to be undervalued and face the "Korea discount" phenomenon according to the Wall Street Journal.[2] Nomura Securities also reported in 2012 that Korea is ranked the fifth highest geopolitical risk country in the world.[3] For this reason, it is important to examine the link between the North Korea risk and the domestic capital market and to further quantify the potential influences of the North Korea risk on domestic stocks.

In this study, we investigate whether geopolitical risk on the Korean Peninsula affects risk components (systematic vs. unsystematic risk) of stocks in the Korean market. In traditional asset pricing theories, political or geopolitical risk is regarded as a systematic risk that cannot be diversified because the risk affects the overall capital market. To our knowledge, however, there is little research about how the North Korea risk affects risk components of Korean stocks. In this study, we use a novel measure that reflects the seriousness of North

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1. Kim Jong-un conducted a total of 20 ballistic missile launches (including intercontinental ballistic missiles) and four nuclear weapon tests between 2012 and 2017.

2. Mohammed Hadi and James Simms, "As ties go south, Korean investors shrug," *The Wall Street Journal*, November 24, 2010, <https://www.wsj.com/articles/SB 10001424052748703572404576633921601247064> (date accessed October 2, 2019)

3. Nomura Securities International Inc., 2011, Global FX Outlook 2012.

Korea's threats using news media reports. Specifically, we use a ratio of the number of news articles mentioning North Korea to the total number of news articles on that day as a proxy for the magnitude of the North Korea risk.

Using the sample period of 2016–2017, we find that the North Korea risk indeed only affects systematic risk (estimated using the Capital Asset Pricing Model) of Korean stocks, and the effect is positive and statistically significant at the 1 percent. This finding suggests that the systematic risk of Korean stocks increases as geopolitical tensions on the Korean Peninsula are escalated. However, we do not find a statistically significant effect of the North Korea risk on the unsystematic risk of the Korean stocks. In robustness, we also test the effect of the North Korea risk when systematic risk is measured in an alternative asset-pricing model (Fama-French three factor model). We show that the baseline results remain unchanged when alternative measures of systematic risk are used. Evidence in our study lends support to a common notion among academics who specialize in finance that the North Korea risk affects the systematic risk of Korean stocks.

This study contributes to the literature in following ways. First, according to a traditional finance theory, a (total) risk of a firm's stock is decomposed into two different types of risk: systematic and unsystematic risk. The uncertainty of the geopolitical relation with North Korea is theoretically considered a systematic risk because the risk is likely to affect a majority of the domestic stocks. Evidence in this study confirms the theoretical view of the North Korea risk as it provides insights on how geopolitical uncertainty affects risk components of Korean stocks.

Second, this study contributes to the existing literature on the effect of North Korea risk on the stock markets. Ahn *et al*. (2010) explore the impacts of good/bad news regarding North Korea risk on the domestic stock markets (KOSPI and KOSDAQ) and show that domestic stocks respond positively to news that relieve the tensions and negatively to news that escalate the tensions on the Korean

Peninsula.[4] Lee (2006) also finds consistent evidence with Ahn *et al*. that domestic stocks are negatively affected by North Korea's nuclear weapon tests.[5] Pak *et al*. (2015) identify good/bad news regarding the North Korea risk using the U.S. media reports and show that the media news reports affect a volatility of prices of Korean stocks that are listed in the U.S. stock market.[6] In this study, we also find the consistent negative impacts of North Korea risk on the domestic stocks: North Korea risk increases the volatility of domestic stock prices and the increase of the volatility of stock prices is attributed to the increase in the systematic risk of the stocks.

Third, our study employs an accurate and effective measure of the seriousness of the North Korea risk on a daily basis. The existing studies analyze the impact of the North Korea risk using an event study methodology where these studies only focus on specific North Korea military actions such as nuclear tests and missile launches. Thus, these studies fail to gauge the dynamics of the North Korea risk and ignore the importance of the events in their analysis. However, in this study, we quantify the magnitude of the North Korea risk every day and use the measure to investigate the impact of the North Korea risk even on days when North Korea military actions are not present. Therefore, our novel measure enables us to conduct a more comprehensive analysis on the effect of the North Korea risk on the domestic equity markets.

Lastly, our study sheds light on a plausible channel through which the "Korea discount" phenomenon occurs. Theoretically, discounted prices of assets may be caused by either decreases in expected cash flows of the assets or increases in investors' required rate of return on

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4. H. J. Ahn, S. P. Jeon, and J. B. Chay, "The Impact of News about Relations between North and South Korea on the Stock Market," *Korean language paper of Korean Institute of Finance*, vol. 16 (2010), pp.200-238.

5. K. Lee, "The impact of news about North Korea on the stock and foreign exchange markets," *Journal of North East Asian Economic Studies*, vol. 18, no. 1 (2006), pp.61-90.

6. Yunjung Pak, Young-Jin Kim, Min Song, and Yong-Hak Kim, "Shock Waves of Political Risk on the Stock Market: the Case of Korean Companies in the U.S.," *Development and Society*, vol. 44, no. 1 (2015), pp.143-165.

the assets. Pastor and Veronesi (2012, 2013) contend that political uncertainty drives stock prices to drop and the decreases in prices are attributed to an investors' higher risk premium for bearing a high political risk.[7] [8] Liu *et al.* (2017) find that the decline in stock prices due to the Bo Xilai political scandal in 2012 in China was driven not by decreases in expected cash flows of politically-connected firms but by increases in the discount rate following the escalated political uncertainty arising from the scandal.[9] Consistent with Pastor and Veronesi (2012, 2013) and Liu *et al.* (2017), evidence in our study suggests that investors will demand a higher risk premium for bearing the increased systematic risk following the North Korea threats, and the stock market tends to discount domestic firms' expected cash flows at a higher discount rate. As a result, domestic stocks sell at a lower price than other similar stocks in foreign countries.

The rest of this paper is organized as follows. In section II, we review the previous literature related to impacts of geopolitical risk and media news reports on the stock markets. Section III describes the sample, data, variable constructions, and our methodology. We present the main regression results and a robustness test in Section IV. The last section provides concluding remarks.

## II. Theoretical Background

### 1. North Korea Risk and the Stock Market

The majority of the studies regarding North Korea risk are those investigating whether and how geopolitical tensions on the Korean

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7. L. Pastor and P. Veronesi, "Uncertainty about Government Policy and Stock Prices" *Journal of Finance*, vol. 67 (2012), pp. 1219-1264.

8. L. Pastor and P. Veronesi, "Political Uncertainty and Risk Premia" *Journal of Financial Economics*, vol. 110 (2013), pp. 520-545.

9. X. L. Liu., H. Shi, and J. K. C. Wei, "The Impacts of Political Uncertainty on Asset Prices: Evidence from the Bo Scandal in China," *Journal of Financial Economics*, vol. 125 (2017), pp. 286-310.

Peninsula affect the South Korean financial markets. Pak *et al*. (2015) employ a novel approach to classify media news from major U.S. newspapers into negative and positive news regarding the geopolitical risk on the Korean Peninsula and investigate the impact of this risk on Korean stocks listed on the New York Stock Exchange (NYSE).[10] They find that the sentiments created by the U.S. media significantly increase the volatility of Korean stock returns in NYSE. Ahn *et al*. (2011) examine the effects of news reports related to North Korea on the South Korean stock markets. They show that bad (good) news negatively (positively) affects stock prices of Korean firms that are closely related to North Korea.[11] Lee (2006) also documents the negative consequences of news reports regarding North Korea's nuclear weapons in the South Korean stock market.[12] Using 13 North Korean military provocations, Gerlach and Yook (2016) show that domestic individual investors tend to decrease whereas foreign investors tend to increase the value of their Korean portfolios during the periods of high geopolitical risk.[13] Further analysis in their study shows that the performance of foreign investors does not improve following the North Korea attacks whereas domestic institutions improve their performance following the North Korea attacks. They conclude that domestic institutions take advantage of aggravated information asymmetry between domestic and foreign investors. In their recent study, Kim *et al*. (2019) create a novel measure of North Korea risk and use it to examine the impact of North Korea risk on

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10. Yunjung Pak, Young-Jin Kim, Min Song, and Yong-Hak Kim, "Shock Waves of Political Risk on the Stock Market: the Case of Korean Companies in the U.S.," *Development and Society*, vol. 44, no. 1 (2015), pp.143-165.

11. H. J. Ahn, S. P. Jeon, and J. B. Chay, "The Impact of News about Relations between North and South Korea on the Stock Market," *Korean language paper of Korean Institute of Finance*, vol. 16 (2010), pp.200-238.

12. K. Lee, "The Impact of News about North Korea on the Stock and Foreign Exchange Markets," *Journal of North East Asian Economic Studies*, vol. 18, no. 1 (2006), pp.61-90.

13. Jeffrey Gerlach and Youngsuk Yook, "Political Conflict and Foreign Portfolio Investment: Evidence from North Korean Attacks," *Pacific-Basin Finance Journal*, vol. 39 (2016), pp.178-196.

trading patterns of domestic institutional investors and foreign investors.[14] They find that domestic institutional investors increase whereas foreign investors decrease the value of their Korean portfolios during periods of high North Korea risk, supporting the view that domestic investors have informational comparative advantages over foreign investors due to aggravated information asymmetry arising from the escalated geopolitical risk on the Korean Peninsula.

### 2. Media and Stock market

Extant studies have also investigated financial and economic impacts of news media on the stock markets. Investors gather information from the news media when valuing a stock and the impact of the news media on investors' investment decisions has been increasing over the past two decades because of the rapid growth of internet technology.

Tetlock (2007) examines the effect of the media on the U.S. market using one of the main daily columns ("Abreast of the Market") from *The Wall Street Journal*.[15] The author shows that media sentiment can predict stock prices and trading volume: high media pessimism predicts a decline in stock prices and unusually high or low pessimism predicts a rise in trading volume. The author concludes that this finding does not support the theory that investors gather new information on fundamental asset values from the media and, rather, it is consistent with the theory that investors are noise and liquidity traders. Fang and Peress (2009) explore the impact of news coverage on expected stock returns.[16] They find that stocks with no media coverage earn higher risk-adjusted returns than those with high media

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14. Young Sik Kim, Keun Jae Park, and Oh Byung Kwon, "Geopolitical Risk and Trading Patterns of Foreign and Domestic Investors: Evidence from Korea," *Asia-Pacific Journal of Financial Studies*, vol. 48 (2019), pp.269-298.

15. Paul Tetlock, "Giving Content to Investor Sentiment: The Role of Media in the Stock Market," *Journal of Finance*, vol. 62, no. 3 (2007), pp.1139–1168.

16. Lily Fang and Joel Peress, "Media Coverage and the Cross-section of Stock Returns," *Journal of Finance*, vol. 64, no. 5 (2009), pp.2023-2052.

coverage. In further cross-sectional analyses, they show that the effect of media coverage on returns is larger for small stocks, stocks with high individual ownership, ones with fewer analysts following, and high idiosyncratic risk. They conclude that news media can lower informational frictions and, as a result, affects stock returns.

Peress (2014) examines influences of news media on financial markets using national newspaper strikes in several countries.[17] The author finds that the trading volume declines by 12% on these strike days, stock returns are less dispersed, and intraday volatility falls by 7%. The author concludes that news media promotes an efficiency of the stock market by alleviating information asymmetry among investors and by incorporating information into current stock prices.

Several studies in Korea have also explored a casual relation between news media and the Korean stock market. Kim *et al*. (2012) examine the impact of news media on stock prices in the Korean stock market and find that sentiment values derived from news contents are significantly associated with the stock price index.[18] In their additional test, they also show that news about the stock market information and foreign news affect stock prices in the Korean market. Seong and Nam (2017) posit that deep learning techniques using online news contents and macroeconomic factors are superior to other techniques when predicting stock prices.[19]

### 3. Big Data and the Stock Returns

Extant literature has examined whether stock prices can be predictable using big data. Most of the studies largely focus on models

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17. Joel Peress, "The Media and the Diffusion of Information in Financial Markets: Evidence from Newspaper Strikes," *Journal of Finance*, vol. 69, no. 5 (2014), pp.2007-2043.

18. Yoo-Sin Kim, Nam-Gyu Kim, and Seung-Ryul Jeong, "Stock-Index Invest Model Using News Big Data Opinion Mining," *Korea Intelligent Information System Society*, vol. 18, no. 2 (2012), pp.143-156.

19. Nohyoon Seong and Kihwan Nam, "Combining Macro-economical Effects with Sentiment Analysis for Stock Index Prediction," *Entrue Journal of Information Technology*, vol. 16, no. 2 (2017), pp.41-54.

that predict stock prices through data mining and sentiment analysis. Bollen *et al*. (2011) find that sentiment analysis based on daily Tweeter feeds can predict 87.6% of the daily up and down changes of the Dow Jones Industrial Average.[20] Preis *et al*. (2013) argue that human interaction creates enormous amounts of new data that can explain the behaviors of individual investors in the financial markets.[21] Using Google query volumes for search terms, the authors show that the behavioral data sets can predict stock price movements. Bank *et al*. (2011) document that search volume in Google is positively correlated with trading volume and liquidity of stocks, and further with higher yields in the future.[22] Da *et al*. (2010) also claim that search frequency in Google has a predictive power for future stock prices.[23]

Among domestic studies, Lee *et al*. (2014) investigate whether online stock discussion forums can predict stock prices in the Korean stock market.[24] They find that the correlation between the number of posts on the forums and stock prices has a significant predictive power for future returns. Using big data from January 2011 to January 2013, Lee *et al*. (2013) analyze the impact of the nine sentiments on Korean stock market. They show that the sentiments have a certain pattern that explains stock prices.[25]

20. Johan Bollen, Huina Mao, and Xiaojun Zeng, "Twitter Mood predicts the stock market," *Journal of Computational Science*, vol. 2, no. 1 (2011), pp.1–8.

21. Tobias Preis, Helen Susannah Moat, and Eugene Stanley, "Quantifying Trading Behavior in Financial Markets using Google Trends," *Scientific Reports*, vol. 3 (2013), pp.1-6.

22. Matthias Bank, M. Larch, and G. Peter, "Google Search Volume and Its Influence on Liquidity and Returns of German Stocks," *Finance Market Portfolio Management*, vol. 25, no. 3 (2011), pp.239-264.

23. Zhi Da, Josheph Engelberg, and Pengjie Gao, "In Search of Attention," *Journal of Finance*, vol. 66, no. 5 (2011), pp.1461-1499.

24. Yunjung Lee, Gunwoo Kim, and Gyun Woo, "Web Science: The Stock Portfolio Recommendation System based on the Correlation between the Stock Message Boards and the Stock Market," *KIPS Transactions on Software and Data Engineering*, vol. 3, no. 10 (2014), pp.441-450.

25. Deuk Hwan Lee, Hyoung Goo Kang, and Chang Mi Lee, "Autocorrelation Analysis of the Sentiment with Stock Information Appearing on Big-Data," *Korean Journal of Financial Engineering*, vol. 12, no. 2 (2013), pp.79-96.

## III. Research Design, Data, and Sample Selection

### 1. Sample

In this study, we examine whether North Korea risk affects risk components of the Korean stocks. Different from existing studies that rely on either sentiment analysis using big data or event study methodologies, we employ a unique and novel measure to reflect the magnitude of geopolitical tensions on the Korean Peninsula each day and examine whether the geopolitical tensions affect a stock's risk. We use daily media news reports during 2016-2017 to quantify the seriousness of the geopolitical risk. We select this sample period because North Korea's military provocations (e.g. missile launches and nuclear weapon tests) occurred more frequently than in any other given period in the past.[26]

When quantifying the seriousness of the North Korea risk, we extract daily news data from a news platform, BigKinds.[27] The news platform is operated by a Korean quasi-government organization and offers media news reports from various media sources (e.g., major TV broadcasters, newspapers, and economic magazines) to the public. We only extract daily news data from four major TV broadcasters (MBC, OBS, SBS, and YTN) for our study because these broadcasters have established the highest brand value and public trust and had higher news productivity and competitive advantages compared to other news media (Park and Oh, 2016).[28] Big data from news reports is not only massive in size, but also contains a mix of different types of data. Due to this, the data should be controlled for potential bias, missing information, and any errors that the data can possibly generate (Park, 2016). As a result, a total of 431,867 news reports are identified in the sample. After we exclude irrelevant and duplicated reports, a total of

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26. In 2017, North Korea launched missiles 15 times, and this number is unusually higher than in any other previous year.

27. www.kpf.or.kr

28. We exclude KBS as Bigkinds does not provide its news data.

393,219 news articles are finally used for our study.[29]  Table 1 reports a number of news articles that are excluded and finally used for our analysis.

**<Table 1> Number of Articles Used for Analysis**

| Year | Total articles | Excluded articles | Sample articles |
|---|---|---|---|
| 2016 | 215,334 | 19,579 | 195,755 |
| 2017 | 216,533 | 19,069 | 197,464 |
| N | 431,867 | 38,648 | 393,219 |

Note: This table describes the total number of news articles available from the major four Korean broadcasting stations (MBC, OBS, SBS, and YTN) and the number of news articles excluded from the sample from 2016 to 2017.

To investigate the impact of the North Korea risk on risk components of individual stocks, we select the sample firms if a firm is listed on the Korean stock markets as of the end of 2017. A firm is excluded if it is a financial firm, acquired, or delisted during the sample period. We only include firms whose fiscal year is December to use consistent accounting information across the sample firms. The final sample includes 697 firms, and it consists of 509,507 firm-day observations. We extract firm-level financial data from Data Guide.

## 2. Variables

### a. Risk Components of Stocks

In finance, risk is defined as uncertainty of future returns on investments, and it is empirically measured by a volatility of returns. The (total) risk is then largely decomposed into two types of risks: systematic and unsystematic risk. Systematic risk refers to a market risk that cannot be eliminated through diversification because this type

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29. A typical example of an irrelevant news report is a routine report such as weather news reports. An example of a duplicate article is one that is rebroadcasted with the same subject by the same broadcaster.

of risk affects all or a majority of the stocks in the market. For example, unexpected changes in an inflation rate, interest rate, economic conditions, and unanticipated natural disasters are likely to affect the entire financial market. In contrast, unsystematic risk refers to firm-specific risk or idiosyncratic risk, and it can be eliminated through diversification because this type of risk is not likely to affect a majority of the stocks. The unsystematic risk can be diversifiable because unexpected negative (positive) firm-specific events are likely to be cancelled out with unexpected positive (negative) events of other constituent stocks within a well-diversified portfolio. For instance, a fire at a company's headquarters, a labor strike, a lawsuit, a sudden death of a CEO, etc. are not likely to affect the rest of the stocks in the market.

$$TRISK = SRISK + URISK$$

TRISK : Total risk
SRISK : Systematic risk
URISK : Unsystematic risk

Total risk, systematic risk, and unsystematic risk are measured as follows. First, the total risk (*TRISK*) is computed as the standard deviation of daily returns. A standard deviation of daily returns is calculated based on a window of the previous 22 business days. For example, to compute the total risk of stock *i* on January 1, 2016, we calculate a standard deviation of daily returns of stock *i* from December 10, 2015 to January 1, 2016. Similarly, we obtain the total risk of stock *i* on January 2, 2016 by computing a standard deviation of daily returns from December 11, 2015 to January 2, 2016. In this way, we calculate the total risk of the sample firms to the end of the sample period, December 31, 2017. Second, systematic risk and unsystematic risk are estimated using the Capital Asset Pricing Model (Sharpe, 1964; Lintner 1965, CAPM hereafter).[30][31] They are estimated using the

30. William Sharpe, "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk," Journal of Finance, vol. 19, no. 3 (1974), pp.425–442.

31. John Lintner, "The Valuation of Risk Assets and the Selection of Risky

following regression equation.

$$[E(R_i) - R_f]_t = \alpha_i + \beta_i[E(R_m) - R_f]_t + \varepsilon_{i,t}$$

$E(R_i)$ : Daily return of stock $i$
$E(R_m)$ : Daily return of the market portfolio, m
$R_f$ : Risk-free rate
$\varepsilon_{i,t}$ : Residual of stock $i$

The left-hand side of the equation (dependent variable) is the excess return of stock $i$ that is calculated by subtracting a daily risk-free rate from stock i's return. We use the 91-day monetary stabilization bond rate as a proxy for a risk free rate. An independent variable in the regression is the market risk premium where the market risk premium is computed as a difference between the true market portfolio return and a risk-free rate. We use the Korea Composite Stock Price Index (KOSPI) as a proxy for the market portfolio. We obtain estimates using the same estimation window (22 days) as the total risk. The estimated coefficient on the market premium ($\beta_i$) represents a stock $i$'s systematic risk and the estimated residual ($\varepsilon_i$) represents unsystematic risk. For example, to estimate unsystematic risk of stock $i$ on January 1, 2016, we calculate the excess return of the stock $i$ and the market risk premium by using the data from December 10, 2015 to January 1, 2016. We then regress the excess return on the market risk premium to estimate the systematic risk ($\beta_i$) and unsystematic risk ($\varepsilon_i$) of the stock $i$ on January 1, 2016. In a similar way, we estimate the systematic and unsystematic risk of the 697 sample stocks until the end of the sample period, December 31, 2017.

## b. News Reports Related to North Korea

We use media news reports to quantify the magnitude of the North Korea risk (*NKR*). The variable used in this study regarding the North Korea risk is a ratio of the number of news reports mentioning

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Investments in Stock Portfolios and Capital Budgets," *Review of Economics and Statistics*, vol. 47, no. 1 (1965), pp.13-37.

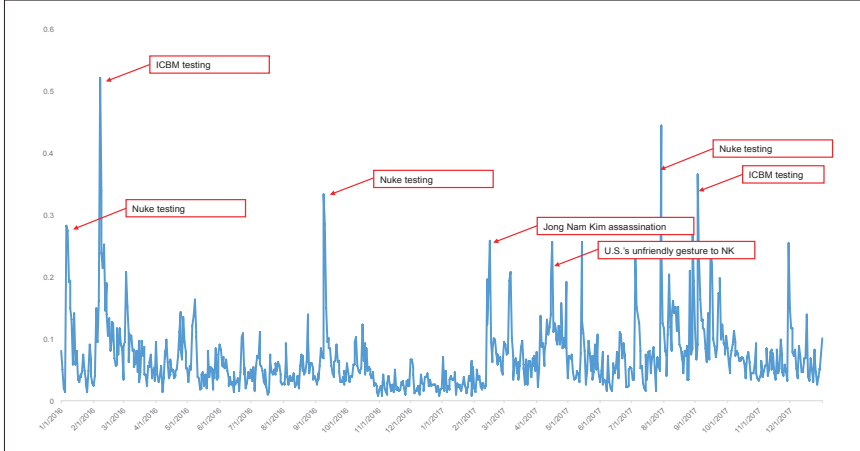North Korea to the total number of news reports on that day.

$$NKR_t = \frac{\text{Total number of news articles mentioning North Korea on day } t}{\text{Total number of news articles on day } t}$$

We identify North Korea-related news reports using the keyword of 'North Korea' after extracting news reports from the political section in a media item because the political section is the most relevant to North Korea. We employ a three-stage filtering method in order to ensure that we do not omit any news reports related to North Korea. For example, some North Korea-related articles in the political section may be searched in the first stage. However, others may be classified in other sections in the first stage (and second stage) but reclassified in the political section in the second stage (third stage). Using the three-stage filtering method, we make sure that no North Korea news report is missing from our analysis.

Figure 1 shows the percentage of North Korea news reports relative to the total number of news reports on that day. The media tends to release more North Korea-related news reports when tensions on the Korean Peninsula are high and release fewer when tensions are low. For example, North Korea's nuclear tests and intercontinental ballistic missile (ICBM) launches generate a high volume of news articles related to North Korea on these dates. Figure 1 clearly shows that our proxy for the North Korea risk accurately reflects a magnitude of the geopolitical risk on the Korean Peninsula.[32]

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32. We do not differentiate a direction of the sentiment (positive/negative) of the news reports related to North Korea because the North Korea risk had been consistently increasing during the sample period. After checking individual daily news reports, we confirm that most of the news reports during the sample period have negative sentiments. For example, CNN summarizes North Korea's military actions related to its nuclear weapons and capability between 1985 and 2019. From the CNN reports, we do not find any positive incidents that relieve the tension on the Korean Peninsula. <https://www.cnn.com/2013/10/29/world/asia/north-korea-nuclear-timeline---fast-facts/index.html> (date accessed October 2, 2019)

**<Figure 1> Time-series Trend of the North Korea Risk Measure**



Note: This figure illustrates a time-series trend of the NKR variable during the period 2016–2017. Major North Korea military provocations including nuclear weapon tests and ballistic missile launches are labeled.

## c. Control Variables

Control variables used in this study are those potentially affecting the uncertainty of stock returns. We use size, illiquidity, and foreign ownership as a control variable. Size (*SIZE*) is proxied by a firm's market capitalization in KRW (in logarithm). Since small stocks have a higher return volatility than large stocks, we expect *SIZE* to be negatively related to a stock's risk.

$$SIZE_{i,t} = ln(SIZE_{i,t})$$

$SIZE_{i,t}$: Market capitalization (KRW) of a stock $i$

We use Amihud (2002)'s illiquidity measure to control for the illiquidity effect on a firm's risk.[33] Illiquidity (*ILIQ*) is calculated as absolute value of a stock i's daily return divided by trading volume in

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33. Yakov Amihud, "Illiquidity and Stock Returns," *Journal of Financial Markets*, vol. 5, no. 1 (2002), pp.31-56.

KRW on that day. A stock with a high ratio indicates that the stock is thinly traded in the market. Therefore, we expect illiquidity to be inversely related to a firm's risk.

$$ILIQ_{i,t} = \frac{[R_{i,t}]}{TA_{i,t}}$$

$[R_{i,t}]$ : Daily return of stock $i$

$TA_{i,t}$ : Total trading volume in KRW

Foreign ownership (*FOR*) can affect a firm's risk. Foreign investors tend to have superior ability and techniques to evaluate a firm's fundamental value and to manage investment risk over domestic investors. Due to informational asymmetry, foreign investors are likely to invest more in stocks with more information transparency. Therefore, we expect that foreign ownership is negatively associated with a stock's risk.

$$FOR_{i,t} = \frac{FS_{i,t}}{OS_{i,t}}$$

$FS_{i,t}$ : Number of shares of stock $i$ owned by foreign investors

$OS_{i,t}$ : Total number of shares outstanding of stock $i$

In addition, we include an indicator variable of year 2017 (*YEAR*) to control for any time-invariant macroeconomic shocks during the sample period 2016–2017.

## 3. Regression Model

We use the following regression model to investigate whether geopolitical risk arising from North Korea threats (*NKR*) affects a stock's total risk (*TRISK*), systematic risk (*SRISK*), and unsystematic risk (*URISK*) in the South Korean market.

$$RISK_{i,t} = \beta_0 + \beta_1 NKR_t + \beta_2 SIZE_{i,t} + \beta_3 ILIQ_{i,t} + \beta_4 FOR_{i,t} + \beta_5 YEAR_t + \varepsilon_{i,t}$$

## IV. Empirical Results

### 1. Summary Statistics and Correlation Matrix

Table 2 reports summary statistics of the variables used for our analyses. The average ratio of the number of news reports mentioning North Korea to the total number of news reports on that day during the sample period is 7%. The average size of the sample firms in the logarithm is KRW 3.78 trillions in KRW, and the illiquidity of the sample stocks is 0.1%. The foreign ownership of the average sample stocks is approximately 10%.

The correlation matrix shows that correlation coefficients among the three types of risks are highly statistically significant at the 1 percent. The total risk is negatively correlated with news reports mentioning North Korea, and the coefficient is statistically significant at the 1 percent, suggesting that a stock's total risk decreases with the ratio of the number of news reports mentioning North Korea to the total number of news reports on that day. The negative correlation coefficient is somewhat surprising and is opposed to our prediction. However, the result may be changed if we implement a regression model that controls for effects of other variables. The signs, magnitudes, and statistical significances of the correlation coefficients between other types of risks (systematic and unsystematic risk) and North Korea news reports are similar to the total risk.

**<Table 2> Descriptive Statistics and Correlation Matrix**

| Variable | Mean | TRISK | SRISK | IRISK | NKR | SIZE | ILQ | FOR |
|---|---|---|---|---|---|---|---|---|
| TRISK | 0.148 | 1 | | | | | | |
| SRISK | 0.103 | 0.998*** | 1 | | | | | |
| IRISK | 0.044 | 0.796*** | 0.740*** | 1 | | | | |
| NKR | 0.069 | -0.014*** | -0.015*** | -0.007*** | 1 | | | |
| SIZE | 14.375 | -0.075*** | -0.072*** | -0.089*** | 0.001 | 1 | | |
| ILQ | 0.001 | -0.029*** | -0.030*** | -0.016*** | -0.001 | -0.063*** | 1 | |
| FOR | 0.103 | -0.131*** | -0.130*** | -0.104*** | 0.001 | 0.579*** | -0.016*** | 1 |
| YEAR | 0.499 | -0.140*** | -0.147*** | -0.053*** | 0.149*** | 0.007*** | 0.000 | 0.020*** |

Note: This table presents a correlation matrix among variables used in our analysis. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

The signs of the correlation coefficients between the total risk and all other control variables are the same as discussed in section III.2.c. The total risk is inversely correlated with a firm's market value, illiquidity, and foreign ownership and all of the correlation coefficients are statistically significant at the 1 percent. The signs, magnitudes, and statistical significances of the correlation coefficients between other types of risks and control variables are also similar to the total risk.[34] The negative coefficient of a dummy variable of year 2017 across all types of risks indicates that a firm's risk is lower in 2017 than in 2016, and the difference is statistically significant at the 1 percent.

## 2. Impact of North Korea-related News Reports

Table 3 presents results of our main regression result. The first, second, and third column show how the North Korea risk affects the sample stocks' total risk, systematic risk, and unsystematic risk respectively. The results in Table 3 show that the North Korea risk variable (*NKR*) positively affects the sample stocks' total risk while

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34. Since none of the correlation coefficients among the independent variables are greater than 0.6, we do not expect our regression analysis to have a multicollinearity problem.

systematic risk and the effects are statistically significant at the 1 percent. However, the North Korea risk does not statistically significantly affect unsystematic risk. The coefficient of *NKR* suggests that the North Korea risk is considered to be those unexpected events that increase a stock's systematic risk rather than unsystematic risk because they affect almost all stocks in the market.

A firm's market size is statistically and negatively associated with only unsystematic risk at the 1 percent confidence level. The coefficients of SIZE indicate that a firm's size can be a diversifiable risk factor that does not affect universal stocks in the Korean market. Illiquidity (*ILIQ*) and all types of risks of the sample stocks are negatively associated and its coefficients are all statistically significant at the 1 percent, indicating that investors perceive illiquid stocks as risky stocks. Foreign ownership (*FOR*) negatively affects all types of risks and its coefficients are all statistically significant at the 1 percent confidence level, suggesting that foreign investors tend to invest in stocks with lower risk.

**<Table 3> Impact of North Korea News on the Risk of Stocks**

| Variables | Expected Sign | Total Risk | Systematic Risk | Unsystematic Risk |
|---|---|---|---|---|
| *NKR* | (+) | 0.003(6.09)*** | 0.003(6.46)*** | 0.000(1.41) |
| *SIZE* | (-) | -0.000(-1.11) | 0.000(1.08) | -0.000(-20.85)*** |
| *ILQ* | (-) | -0.054(-18.39)*** | -0.050(-18.65)*** | -0.004(-11.69)*** |
| *FOR* | (-) | -0.014(-62.89)*** | -0.013(-64.08)*** | -0.001(-36.75)*** |
| *Year* | | -0.004(-82.15)*** | -0.004(-85.99)*** | -0.000(-29.46)*** |
| Cons | | 0.025(108.45)*** | 0.024(111.97)*** | 0.001(53.18)*** |
| R2 | | 0.039 | 0.041 | 0.015 |
| N | | 327,150 | 327,221 | 327,221 |

Note: Table 3 reports the results of the baseline regression models. The t-statistics are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

The evidence in Table 3 offers two important implications. First, geopolitical risk on the Korean Peninsula has been well known as a

systematic risk in academia for affecting the universe of Korean stocks, and that it cannot be eliminated through diversification. Therefore, the finding in Table 3 is consistent with the general perception regarding the North Korea risk in that it increases the volatility of the Korean stock prices and the increase is only attributed to the increase of the systematic risk. We posit that the North Korea risk has a predictability power for a path of the systematic risk change of the Korean stocks. Second, we show that the measure used in our study is a good proxy for the North Korea risk. The extant literature on the effects of geopolitical risk (or North Korea risk) has investigated a predictability of the stock risk by employing sentiment measures based on text mining techniques. In this study, however, we show that the number of news articles mentioning North Korea in the media (relative to the total number of news articles on that day) also accurately captures the North Korea risk.

### 3. Robustness: Alternative Measures of Systematic Risk

In this section, we investigate whether the baseline results in Table 3 hold when an alternative measure of the systematic risk is used in the regression model. In the previous section, we estimate the systematic risk based on the CAPM. However, a drawback of the CAPM is that it considers the market factor the only risk factor predicting stock returns. Fama and French (1992, 1993) introduce a three-factor model (FF-3 model) in which they further include size and value/growth effects of stocks in addition to the market factor.[35] [36] In their regression model, Fama and French use a size premium, value premium, and the market risk premium as independent variables and estimate coefficients of the variables. The coefficient of our interest (systematic risk) is that of the market risk premium. We use the following regression model to estimate the systematic risk.

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35. Eugene Fama and Kenneth French, "The Cross-section of Expected Stock Returns, *Journal of Finance*, vol. 47, no.2 (1992), pp.427–465.

36. Eugene Fama and Kenneth French, "Common Risk Factors in the Returns of Stocks and Bonds," *Journal of Financial Economics*, vol. 33, no. 1 (1993), pp.3–56.

$$[E(R_i) - R_f]_t = \alpha_i + \beta_i[E(R_m) - R_f]_t + s_i SMB_t + h_i HML_t + \varepsilon_{i,t}$$

$E(R_i)$ : Daily return of stock i

$E(R_m)$ : Daily return of the market portfolio m

$R_f$ : Risk-free rate

$\varepsilon_{i,t}$ : Residual of stock i

$SMB_t$ : Return difference between small-cap stock portfolio and large-cap stock portfolio

$HML_t$ : Return difference between high B/M stock portfolio and low B/M stock portfolio[37]

Table 4 reports the results using the FF-3 model. The first two columns of Table 4 show estimated coefficients and corresponding t-statistics (in a parenthesis) when a dependent variable is the systematic risk or unsystematic risk respectively. Similar to the baseline results discussed in the previous section, a ratio of news reports mentioning North Korea to the total number of news articles released on the same day positively affects the systematic risk of the Korean stocks. The coefficient of *NKR* is statistically significant at the 1 percent, suggesting that the North Korea risk will increase the systematic risk. However, we do not find a statistically significant change of the unsystematic risk in response to a change in the North Korea risk. We also test the hypothesis using the estimated coefficient of the market risk premium based on the CAPM as a dependent variable rather than computing the systematic risk by subtracting the unsystematic risk from the total risk. The result is reported in the last column in Table 4. It shows that the coefficient of NKR remains positive and statistically significant at the 1 percent.

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37. SMB is a proxy to reflect size risk premium as small stocks historically earned higher abnormal returns than large stocks. HML is a proxy to capture risk related to the growth potential of a firm. B/M is defined as the book value of equity divided by the market value of equity. The book value of equity is directly obtained from a firm's balance sheet while the market value of equity is a market price per share times the number of shares outstanding for a stock i. High B/M stocks (value stocks) have been reported to earn higher abnormal returns than low B/M stocks (growth stocks) historically. Please see Fama and French (1992, 1993) for more details about variable and portfolio constructions.

In sum, findings in Table 4 indicate that the North Korea risk increases the risk of the stocks in the Korean market overall but the increase is only attributed to an increase in the systematic risk even when alternative proxies for the systematic risk are used.

**\<Table 4\> Robustness Test**

| Variables | Systematic Risk (FF3) | Unsystematic Risk (FF3) | Systematic Risk (CAPM) |
|---|---|---|---|
| *NKR* | 0.003(6.43)*** | 0.000(1.52) | 0.866(22.70)*** |
| *SIZE* | 0.000(1.24) | -0.000(-22.14)*** | 0.050(35.34)*** |
| *ILQ* | -0.050(-18.67)*** | -0.004(-11.69)*** | -1.415(-6.60)*** |
| *FOR* | -0.013(-64.26)*** | -0.001(-36.75)*** | -0.229(-13.77)*** |
| *Year* | -0.004(85.96)*** | -0.000(-27.36)*** | -0.274(-75.94)*** |
| *Cons* | 0.024(111.56)*** | 0.001(53.44)*** | 0.139(8.02)*** |
| R2 | 0.041 | 0.015 | 0.022 |
| N | 327,150 | 327,150 | 320,960 |

Note: Table 4 presents the results of robustness tests. The t-statistics are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

## V. Conclusion

This study examines the impact of geopolitical tensions on the Korean Peninsula on the risk of stocks in the Korean stock market. Using media news data, we construct a novel measure of the seriousness of the North Korea risk. During the sample period of 2016–2017, we find that geopolitical risk positively affects the systematic risk component of stocks but does not affect the unsystematic risk component of stocks. These results are robust when we employ alternative measures of the systematic risk.

Evidence in this paper provides two important implications on the relation with North Korea and possibly on Korean reunification in the future. First, this study analyzes the influences of the North Korea threats in the domestic capital markets. Despite great interests in a

peaceful relation with North Korea and Korean reunification, there exist only a few studies investigating the potential impact of the North Korea threats on the domestic capital markets. This study provides helpful insights to practitioners and politicians in that it shows that North Korea threats cause domestic stock prices to be more volatile, and they increase the systematic risk of the domestic stocks. As a result, investors require a higher risk premium for bearing the increased systematic risk following North Korea threats. This study, therefore, helps the government to form constructive and effective policies regarding its relation with North Korea. Additionally, evidence in this study also contributes to the literature on North Korea risk in that we employ a novel measure of the North Korea risk and quantify the impact of the risk on domestic stocks.

Second, if one looks at relationships with North Korea in the past, geopolitical tensions on the Korean Peninsula were low (high) when domestic firms' contributions to the North Korea economy were increased (decreased or discontinued). In other words, economic cooperation between the two Koreas plays an important role in relieving geopolitical tensions on the Korean Peninsula. Currently domestic stocks tend to be undervalued compared to otherwise similar stocks in foreign countries because the North Korea risk is present (so called "Korea discount"). This is because investors require a higher rate of return on domestic stocks than similar foreign stocks because they have to bear additional systematic or undiversifiable risk arising from the tensions in inter-Korean relations. Therefore, in order to alleviate the "Korea discount" phenomenon, a peaceful relationship between South and North Korea should be established in the future. To support the idea, future research should be followed by extending the sample period and investigating how differently North Korea risk affects the domestic capital markets during peaceful periods and high geopolitical tension periods.

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