Motivation and Overview:

There is a growing sense of geopolitical risk in the US today, partly brought on by a Presidential administration marked by uncertainty and rising tensions of nuclear war with North Korea . Bloomberg has noted that markets around the globe have remained very calm despite this, which they attribute to an inability of investors to quantify these macro risks. Equity prices are at historic highs and the gap between yields on risk free and risky assets continues to narrow as investors seek higher returns in a persistently low interest rate environment—investors aren't ditching risky investments. Furthermore, volatility in financial markets, which is a typical measure of risk, is at a historic low. We do know though of course that geopolitical shocks move the market, and there are several prominent examples from 2017 already. Most of these shocks have surrounded US tensions with North Korea, but other notable shocks include the recent US attack on a Syrian airbase. It's not unheard of for geopolitical shocks to impact the US financial markets. For example, the Iraq invasion of Kuwait resulted in a 3% drop and the Cuban Missile Crisis a 4% drop in the Dow Jones (over a 1-day period). Recently, tweets and comments made in passing by President Trump, mostly in reference to the current nuclear tensions with North Korea have been significant market movers. The S&P500 fell nearly 1.5% in the two days following Trump saying that North Korea would be met with "Fire and fury" if they kept threatening to attack the US or its allies. Markets in Europe reacted even more, with several indexes falling over 2% in the days following the comment. Additionally, North Korea's frequent testing of missiles, and recently the test of what is suspected to be a hydrogen bomb, have had tangible impacts on financial markets.

In almost all these cases though, the market recovers after a couple of days. It seems that this recovery isn't just a price correction from a market overreaction, but rather represents an inability of investors to quantify the increase in a macro risk that affects all investments. In essence, the entire market becomes inherently riskier, yet it is not firm specific or asset class specific so it is difficult for investors to take this risk into consideration and adjust their portfolios accordingly. There is very little literature that analyzes in detail investor reactions to macro geopolitical shocks of this nature. Which stocks and industries are most heavily sold off?

Which ones are bought? Are there any predictable patterns in the market whenever, for example, North Korea tests a missile?

To answer these questions, we structure the paper with two central questions. First, we ask "What is this Risk?". We begin this section by describing theoretically what risk is, the various ways risk might be described, and how risk relates to asset pricing. This is intended to give the reader a holistic understanding of what we mean by "risk" and we rely heavily here on existing literature. We then transition to define what we mean by geopolitical risk, how it has changed through time, and distinguish it from other forms of risk, such as political. This section will highlight our use of the Geopolitical Risk index (GPR) created by Caldara and Iacoviello (2017). This is a cutting-edge index that quantitatively measures geopolitical risk every month based on word and phrase counts in major newspapers and allows for macro-analyses of the impact of geopolitical risk. We then examine the relationship between this GPR index and the monthly returns of various portfolios with specific characteristics. We rely heavily on industry, momentum, size, B/M, profitability and other portfolios created by Eugene Fama and Kenneth French. By examining the impact of geopolitical risk on these types of portfolios (amongst others) we discern what exactly geopolitical risk is affecting. In seeing what it affects, we can better understand what actually the risk is itself. We implement a Fama-Macbeth 2-pass regression to determine if, and to what degree, risk is priced in each of these portfolios.

The next question we ask is "How is this risk impounded?." There are currently no indexes that measure geopolitical risk on a basis more frequent than monthly. As mentioned in the motivation, the effects of specific shocks though tend to dissipate after days, if not hours. It is therefore not possible to accurately examine how this risk is impounded over such a month-long time horizon. To examine this question, we look specifically at geopolitical shocks associated with North Korea. We chose to examine shocks related to North Korea for a variety of reasons. First, North Korea has increasingly been in the news over the past year, which makes it a contemporary and important topic of research. Secondly, and related to the first, there are large number of geopolitical shocks resulting from North Korea. This allows us to analyze several different events and reduce possible noise that is associated with looking at few events. Lastly, geopolitical shocks related to North Korea are easily identified and are rather

consistent in nature throughout time. For example, we can pinpoint the exact time that North Korea tested a ballistic missile or a nuclear weapon and when financial markets received that information. Furthermore, we can compare similar shocks, such as the missile tests, throughout time to determine if the way this information is impounded has changed. We perform a series of event studies to determine the length and magnitude of various geopolitical shocks related to North Korea on returns, volatility, and volume of the stock market. Precise time-stamps of the events and high-frequency market data are utilized to examine exactly how investors impound the shock into their investment decisions. We attempt to identify patterns in how the market reacts to these shocks and if the nature of the shock (missile test versus nuclear test versus nuclear threat) results in different reactions from the market. Furthermore, we examine from other angels how investors impound this information outside of what shows up in the aggregate market. For example, measures of investor sentiment are used to identify if North Korea related geopolitical shocks effect sentiment and how long this effect typically lasts. Lastly, these event studies are compared to other more traditional information impoundments such as GDP and earnings releases to further accentuate differences between risk associated with geopolitical risk and other more traditional market risks.

This paper then attempts to add to the existing literature in two main ways. First, it expands the existing application of the new Geopolitical Risk index created by Caldara and Iacoviello. While existing literature has demonstrated that geopolitical risk, and the GPR specifically, have a negative relationship to returns and a positive relationship to volatility, these have been studied on the aggregate market level. We take a more granular approach and apply a Fama-Macbeth methodology to discern more specifically what the geopolitical risk is affecting in the market and the relationship between various types of portfolios and this risk. We hope then to better describe the nature of this geopolitical risk that Caldara and Iacoviello identified. Second, there is a gap in the existing literature regarding how geopolitical risk is impounded in the market on a high-frequency basis. Focusing on North Korea makes the subject very pertinent to the current geopolitical climate and allows us to identify the contemporary investor's response to geopolitical shocks that happen on a semi-frequent basis. Furthermore, this focus on North Korea enables a discussion surrounding how investors react to

risks that are not specific to any one company or type of asset in their portfolio. Essentially, how are investors reacting to a shock that makes the entire economy riskier to operate in? And are there predictable patterns to this reaction?

Outline:

1. Well documented that armed conflicts have a real impact on the real economy
    a. Bloomberg, Hess, and Orphanides (2004) find that both war and terrorism have an economically significant negative effect on growth and that the effect of terrorism is smaller and less persistent than that of wars
    b. Glick and Taylor (2010) find large and persistent impacts of war on trade, national income, and global economic warfare

2. There appears to be a disconnect between the effects on the real economy and the effect on financial markets
    a. Casual evidence that markets tend to quickly recover after major armed conflicts commence or the threat of a major armed conflicts. Though there certainly negative short term effects of these shocks
    b. Schneider, Troeger (2006) study the affects of armed conflict from 1990 to 2000 on global financial markets. They note that it has been well established that armed conflict is bad for the real economy—they also point out that this is a negative effect that often lasts for years after an armed conflict. Again though, they say that the negative impacts on returns seems to only last short-term and that the information isn't taken into account in the long-term
        i. Focus on 3 major conflicts to study. They examine events within these conflicts, such as increases in cooperation or confrontation, and the effect that this has on returns
        ii. Find that the day to day changes of events within the conflict are not apparent. But increases in volatility is identified as a symptom of a

market suffering from political uncertainty. Furthermore they conclude that unexpected armed conflict unambiguously negatively affects the market

1. They note some outlier cases where a conflict has a positive impact, though this is because investors perceive it as coming closer to a resolution (i.e. a major assault to end a war)

3. Uncertainty appears to drive the increases in volatility and negative impact on returns
    a. Pástor and Veronesi (2013) find that uncertainty commands a risk premium. Stocks are more volatile and more correlated in times of high uncertainty.
    b. Kelly, Pastor, and Veronesi analyze the pricing of political uncertainty. They isolate political uncertainty by looking at specific events of elections and global summits. They show that, in accordance with theory, options priced whose lives span these political events tend to be more expensive. These options are riskier than ones that exist before or after the political event. They also identify different pricing in weak versus strong economic conditions

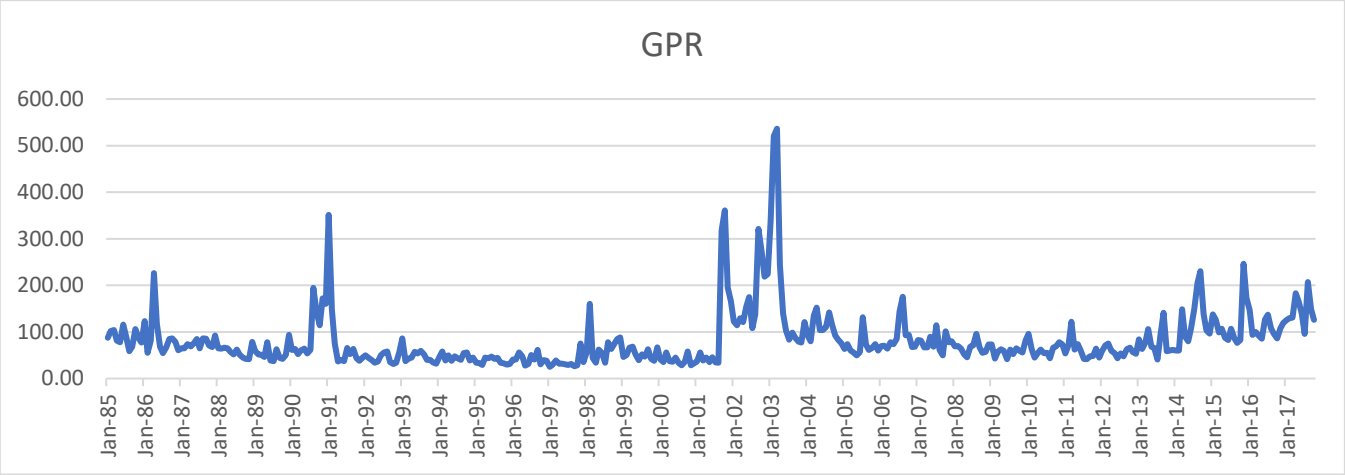
4. Geopolitical shocks have been well documented to negatively affect market stock returns and increase volatility
    a. Markets are factoring in an additional risk and uncertainty that decreases the price on aggregate of the market
    b. Pástor and Veronesi (2013) find that uncertainty commands a risk premium. Stocks are more volatile and more correlated in times of high uncertainty.
    c. We want to apply a framework of uncertainty to geopolitical shocks. How does the uncertainty caused by geopolitical events impact financial markets? How do investors react to this type of uncertainty? Is geopolitical uncertainty different that other types of uncertainty?

5. Measures of armed conflict/geopolitical risk
    a. One of the most common ways to measure armed conflict/geopolitical risk on a regular basis is to create an index based off news sentiment. The news sentiment is thought to capture the general attitude toward armed conflict risk during a given time period
    b. Caldara and Iacoviello (2017) create a monthly index for geopolitical risk. Based on a tally of newspaper stories with terms related to geopolitical tensions. They affirm with this index that higher geopolitical risk leads to increases in implied volatility (measured by VIX). They also find that it leads to higher corporate credit spreads—capital flow away from risky companies. Furthermore they affirm that higher geopolitical risk as measured by this index leads to lower stock returns.
        i. News Papers used: The Boston Globe, Chicago Tribune, The Daily Telegraph, Financial Times, The Globe and Mail, The Guardian, Los Angeles Times, The New York Times, The Times, The Wall Street Journal, and The Washington Post
        ii. Key search words used: geopolitical risk(s)", "geopolitical concern(s)", "geopolitical tension(s)", "geopolitical uncertainty(ies)", "war risk(s)" (or "risk(s) of war"), and "military threat(s)", "terrorist threat(s)", "terrorist act(s)
            1. Index counts the occurrence of words related to geopolitical tensions in leading international newspapers
        iii. They have several different subsets of words and phrases to identify geopolitical risk resulting from actual action versus geopolitical risk resulting from threats. This will prove useful to make our analysis more granular
    c. Importantly, we do not use gold or VIX as a measure of increases in geopolitical risk like some literature/other indexes do. These are reactionary variables themselves to the geopolitical risk

d. We also separate out threats of armed conflict /geopolitical risk versus actual action similar to Caldara et. Al (2017) since they showed that they two classes have different impacts on markets
    i. Further extension would be to make separate variables for positive and negative news sentiment. Several studies have documented an asymmetric relationship where negative news has a much greater impact than positive news
        1. We can examine if the relationship between GPR and asset pricing is asymmetric—in other words, does an increase in GPR more negatively affect returns than a decrease positively affects?
e. These indexes are more focused on geopolitical events in general, though the one created by Caldara et. al does have a focus on violent geopolitical events. This is still a very broad index and might not get at geopolitical risk on the large scale we are want (for example, their measure includes words related to terrorist attacks that likely don't make an economy inherently more risky)
f. Use the geopolitical risk index developed by Caldara and Iacoviello (2017) entitled GPR to measure geopolitical risk on a monthly basis
    i. The relationship between this index and market-wide returns (on a monthly basis) and volatility has been sufficiently studied

6. We first ask "What is this Risk?" associated with geopolitical shocks
    a. Data:
        i. We import the GPR index and EPU (Economic Policy Uncertainty) into MATLAB. GPR is broken up into the main overall index and two sub-indexes for geopolitical threats and actions
            1. GPR and EPU data is monthly and ranges from January, 1985 to September 2017

i. Graph the data and highlight points of spikes in GPR (and the associated geopolitical shocks)



i. Descriptive statistics of data:

a. The index is normalized to an average value of 100 for the 2000-2009 decade. So, a value of 200 means that there were twice as many hits to key words or phrases measuring geopolitical risk during that month. On average, there has been less geopolitical risk as measured by the GPR than on average in the 2000-2009 decade. The highest month witnesses a score of 536, indicating over 5 times as many hits on key words as on average during the 2000-2009 decade. The data is slightly skewed right with a relatively high positive kurtosis, indicating large magnitude index values happen frequently

ii.

GPR Descriptive Stats	
Mean	80.735
Standard Error	3.023
Median	64.298
Mode	NA
Standard Deviation	59.920
Sample Variance	3590.392
Kurtosis	18.963
Skewness	3.615
Range	511.075
Minimum	25.150
Maximum	536.225
Count	393

iii. Import portfolio return data from Kenneth French website

a. Portfolios imported: 49 industry portfolios, 10 momentum portfolios, 10 size portfolios, 10 Book-Market portfolios, 9 operating profit portfolios, 9 investment portfolios

b. Each of these groups of portfolios is constructed differently. The industry portfolios are rather straight-forward—each industry portfolio contains stocks pertaining to that industry. The size portfolios contain various size groupings. For example one portfolio contains all stocks in the bottom 30% in stock size, while another portfolio contains all stocks in the top 10% in stock size. The same type of portfolio groupings applies to the book-market, investment, and operating profit portfolios. The momentum portfolio is unique in that it constantly regroups

stocks based on their momentum over the prior month, two month, three month, etc. period

c. Important to note that every data point in these portfolios represents the months returns
d. Clean the data (Jan. 1985-Sept. 2017)

b. Methodology: Fama-Macbeth 2-Pass
    i. Goal is to determine betas and risk premia across various portfolios of stocks to determine relationship between the various types of portfolios and geopolitical risk
    ii. Ross (1976) shows that a linear factor structure admits the following relation, which forms the basis for virtually all tests of factor models
        1. $E[r] = rf + \beta\lambda$
        2. Expected Excess Return = Factor Exposure × Factor Premia
    iii. First pass of the regression
        1. Regress the GPR and against every portfolio of stocks. Collect the Betas and T-stats on each of these portfolios

Industries

	Intercept	Beta	T-stat		Intercept	Beta	T-stat
'Agric'	1.1387	-0.00123	-0.275	'Ships'	1.5140	-0.00625	-1.084
'Food '	1.5077	-0.00413	-1.264	'Guns '	0.9833	0.00285	0.446
'Soda '	1.5105	-0.00357	-0.568	'Gold '	1.6545	-0.01076	-1.447
'Beer '	1.7468	-0.00517	-1.661	'Mines'	1.7831	-0.00802	-1.527
'Smoke'	2.1818	-0.00836	-1.066	'Coal '	1.0879	-0.00142	-0.137
'Toys '	0.7007	0.00149	0.240	'Oil '	1.3661	-0.00472	-1.349
'Fun '	1.5515	-0.00199	-0.333	'Util '	1.3328	-0.00494	-1.308
'Books'	0.9781	-0.00213	-0.522	'Telcm'	1.4344	-0.00605	-1.171
'Hshld'	1.0175	-0.00035	-0.102	'PerSv'	0.8408	-0.00091	-0.227
'Clths'	0.7851	0.00414	0.646	'BusSv'	1.0441	-0.00097	-0.185
'Hlth '	1.2973	-0.00572	-1.176	'Hardw'	0.7211	0.00348	0.358
'MedEq'	0.8831	0.00427	1.187	'Softw'	1.0582	0.00474	0.602
'Drugs'	1.5013	-0.00312	-0.848	'Chips'	1.2721	-0.00111	-0.123
'Chems'	1.2307	-0.00104	-0.215	'LabEq'	1.0065	0.00090	0.136
'Rubbr'	1.1337	0.00025	0.053	'Paper'	1.2168	-0.00259	-0.691
'Txtls'	1.1460	-0.00035	-0.059	'Boxes'	1.0331	0.00134	0.253
'BldMt'	1.2876	-0.00197	-0.406	'Trans'	1.1506	-0.00147	-0.292
'Cnstr'	0.8060	0.00264	0.443	'Whlsl'	1.4388	-0.00677	-1.942
'Steel'	1.1589	-0.00441	-0.631	'Rtail'	1.1030	0.00049	0.098
'FabPr'	1.2222	-0.00610	-0.990	'Meals'	1.4034	-0.00344	-0.683
'Mach '	1.2507	-0.00154	-0.248	'Banks'	1.4015	-0.00407	-0.915
'ElcEq'	1.6824	-0.00551	-1.056	'Insur'	1.4135	-0.00398	-0.936
'Autos'	1.6441	-0.00927	-1.437	'RlEst'	0.7397	-0.00301	-0.741
'Aero '	1.9793	-0.00980	-1.448	'Fin '	1.6049	-0.00486	-0.833
				'Other'	0.7183	-0.00053	-0.089

Book-Market

	Intercept	Beta	T-stat
'<= 0'	0.6335	0.00553	1.142134
'Lo 30'	1.1189	-0.00125	-0.30475
'Med 40'	1.3713	-0.00444	-1.23548
'Hi 30'	1.6924	-0.00723	-1.78676
'Lo 20'	1.0877	-0.00109	-0.26842
'Qnt 2'	1.3647	-0.00363	-0.88671
'Qnt 3'	1.4097	-0.00431	-1.29132
'Qnt 4'	1.3243	-0.00432	-1.05463
'Hi 20'	1.9242	-0.00894	-2.10048
'Lo 10'	0.9803	-0.00026	-0.06407
'12/2/2017'	1.3087	-0.00293	-0.68504
'12/3/2017'	1.3371	-0.00250	-0.56458
'12/4/2017'	1.4218	-0.00516	-1.33527
'12/5/2017'	1.3524	-0.00363	-1.01212
'12/6/2017'	1.5215	-0.00538	-1.63879
'12/7/2017'	1.2403	-0.00339	-0.80556
'12/8/2017'	1.4333	-0.00534	-1.32629
'12/9/2017'	1.9089	-0.00858	-2.13342
'Hi 10'	1.9335	-0.00922	-1.58719

Operating Profit

	Intercept	Beta	T-stat
'Lo 30'	1.0167	-0.00273	-0.53316
'Med 40'	1.1512	-0.00237	-0.58378
'Hi 30'	1.3214	-0.00276	-0.77645
'Lo 20'	0.9138	-0.00230	-0.42574
'Qnt 2'	1.2713	-0.00393	-0.95093
'Qnt 3'	1.1709	-0.00243	-0.57426
'Qnt 4'	1.2351	-0.00227	-0.60567
'Hi 20'	1.3297	-0.00291	-0.81099
'Lo 10'	0.6752	-0.00052	-0.08199
'12/2/2017'	1.1452	-0.00401	-0.83071
'12/3/2017'	1.2200	-0.00393	-0.82839
'12/4/2017'	1.2859	-0.00363	-0.98141
'12/5/2017'	1.2390	-0.00303	-0.66756
'12/6/2017'	1.1415	-0.00193	-0.47898
'12/7/2017'	1.1225	-0.00204	-0.49816
'12/8/2017'	1.3452	-0.00262	-0.71444
'12/9/2017'	1.3469	-0.00285	-0.74985
'Hi 10'	1.3372	-0.00323	-0.91542

Size

	Intercept	Beta	T-stat
'<= 0'	-99.9900	1.89E-16	3.450775
'Lo 30'	1.2096	-0.00186	-0.37088
'Med 40'	1.2662	-0.00203	-0.43343
'Hi 30'	1.2190	-0.00287	-0.75801
'Lo 20'	1.1882	-0.00206	-0.41916
'Qnt 2'	1.1801	-0.00127	-0.24578
'Qnt 3'	1.2570	-0.00195	-0.40044
'Qnt 4'	1.3599	-0.00291	-0.6435
'Hi 20'	1.2149	-0.00291	-0.77771
'Lo 10'	1.0436	-0.00037	-0.07871
'12/2/2017'	1.3274	-0.00346	-0.66108
'12/3/2017'	1.2700	-0.00169	-0.325
'12/4/2017'	1.1158	-0.00098	-0.19042
'12/5/2017'	1.2375	-0.00172	-0.32631
'12/6/2017'	1.2726	-0.00213	-0.46053
'12/7/2017'	1.3508	-0.00262	-0.60862
'12/8/2017'	1.3589	-0.00303	-0.648
'12/9/2017'	1.2466	-0.00195	-0.502
'Hi 10'	1.2182	-0.00317	-0.84489

Investment

	Intercept	Beta	T-stat
'Lo 30'	1.471825	-0.00432	-1.10982
'Med 40'	1.335672	-0.00356	-1.05064
'Hi 30'	1.009587	-0.00104	-0.22778
'Lo 20'	1.535108	-0.00431	-1.01341
'Qnt 2'	1.359572	-0.0036	-1.0433
'Qnt 3'	1.38733	-0.00435	-1.21303
'Qnt 4'	1.295912	-0.00313	-0.84015
'Hi 20'	0.933247	-0.00037	-0.07739
'Lo 10'	1.409157	-0.00373	-0.82643
'12/2/2017'	1.581696	-0.00441	-1.02552
'12/3/2017'	1.381551	-0.00403	-1.03511
'12/4/2017'	1.353372	-0.00312	-0.96864
'12/5/2017'	1.385348	-0.00381	-1.05169
'12/6/2017'	1.397427	-0.00474	-1.27496
'12/7/2017'	1.287326	-0.00284	-0.8082
'12/8/2017'	1.309374	-0.00327	-0.80182
'12/9/2017'	1.032762	0.000395	0.088956
'Hi 10'	0.835219	-0.0014	-0.2623

Momentum

	Intercept	Beta	T-stat
'Lo PRIOR'	-0.1304	0.00579	0.664013
'PRIOR 2'	0.9251	-0.00110	-0.17208
'PRIOR 3'	1.0561	-0.00100	-0.18333
'PRIOR 4'	1.1723	-0.00149	-0.33273
'PRIOR 5'	1.1201	-0.00168	-0.51919
'PRIOR 6'	1.0618	-0.00122	-0.37864
'PRIOR 7'	1.2609	-0.00319	-1.06308
'PRIOR 8'	1.5928	-0.00550	-1.94144
'PRIOR 9'	1.2548	-0.00267	-0.97275
'Hi PRIOR'	1.6082	-0.00267	-0.70051

2. These betas appear to demonstrate a consistently negative relationship between portfolio returns and the GPR index. Further analysis will be performed to determine which portfolios demonstrate the largest relationship and if there are any patters within the portfolio groups. For example, do larger size portfolios demonstrate a larger (smaller) relationship to the GPR? What about larger book-to-market ratio portfolios? Etc.
3. Some of the t-stats are verging on statistical significance, but they aren't quite. This initial finding might indicate that while GPR does have a relationship with the market in aggregate, the relationship does not show up on a more granular level
4. Another extension might be to add the GPR to the 3-factor model itself and then run the model to determine if GPR adds to the model's ability to explain returns. GPR might be such a small part of what determines returns on a monthly basis for these portfolios that it is not showing up as a significant indicator

iv. Second pass of the regression
    1. Run the second pass the regression. This is a cross section regression at one point in time where we regress the betas of each portfolio against the returns for that portfolio for a specified month. We can then average all of these lambdas to determine the average factor loading for each portfolio group.
    2. Still need to work out how we are going to approach this second regression. We need more portfolios to accurately do a cross sectional regression (for example, we can't perform this when the momentum portfolio group only has 10 portfolios within it)
v. Interpret the results

c. Is GPR different from political risk in general (use the EPU political uncertainty index)
    i. GPR is more focused on violence but EPU captures some of GPR events
    ii. Magnitude of effect, predictability of effect. Could make more granular and examine abnormal volume and volatility
    iii. Run the same Fama-Macbeth style regressions performed on GPR on EPU
        1. Compare the Betas and Factor loadings between GPR and EPU

7. How is this risk impounded?
    a. We examine specifically the prominent case of North Korea and related geopolitical tensions
    b. Event study methodology to examine how the market reacts to shocks from NK (missile tests, "Fire and Fury", anything that spikes the NK mentions in the news)
    c. Data:

i. Identify North Korean geopolitical shocks. Ravenpack has the exact time stamps of when events reached the US news. Group the events into categories such as “Missile tests”, “Nuclear Tests,” “Nuclear War Threats”
    1. Load the dates and time stamps into Matlab
ii. We will use high-frequency data on market returns from Trade and Quote (TAQ) data base
iii. Use SPY exchange traded fund as the proxy for market performance (SP500)
iv. Balduzzi, Elton, Green (2001) demonstrate the use of event studies in high-frequency settings to determine the effect of macroeconomic announcements on asset prices
v. Focus on abnormal returns that result from these shocks using event study methodology. This also more explicitly focuses on the duration of the impact of a shock on negative returns
    1. Calculate cumulative abnormal returns on a second-to-second basis. Employ similar methodology to Balduzzi et. al. Expand to 1, 2, 3 etc. day horizons to determine long term effect of shock
    2. How to calculate expected returns? With high-frequency data, we can just look at the price from several seconds or minutes ago and use this as what we expect the price to be in the next minute period. For days, other literature uses average over past 100 days, but maybe we use Fama 5 factor model. Obviously these factors could be capturing in them the effect of the shocks—which leads to why we later add a new factor to capture these shocks to see if significantly adds explanatory power
    3. Calculate statistical significance. Basically a t-stat based on the variation of the price and its typical standard deviation
vi. We apply the same process to abnormal volatility and volume to determine how long the abnormal effects last. How long does it take

investors to process the information and begin trading? How long after the information is released do we witness peak activity? How long till activity returns to normal? We will be able to pinpoint this to the second and analyze if different categories of shocks have different (and predictable) effects on investor behavior

d. Compare this to other more traditional information impoundments such as GDP and earnings releases. Fast, slow? Longer or shorter lasting effects?
    i. Length of effect, magnitude of effect, predictability of effect
    ii. These effects have been extensively studied. No need to reinvent the wheel here, we can compare their results to our findings on North Korean shock information impoundments

e. Examine other angles on how investors react to these shocks
    i. Does it trigger hedging? Look at net long/short positions
        1. Data available through several banks (i.e. TD)
        2. Currently trying to get the hedging data more granular. But could still look at it in aggregate, and look at the relationship on a monthly basis between the GPR and net long/short positions. Another way to examine if investors have predictable behavior that might not be showing up obviously in stock returns
        3. If we can find more granular data, again use event study—how do net long/short positions change after a shock from NK? Length of effect? Magnitude?
    ii. Investor sentiment indexes—any relationship?
        1. Several measures of this—effect of shocks might not be showing up in returns etc., but rather just how investors view the overall economy. Shifting sentiment does not necessarily trigger investor action. This would be used to accentuate other findings in the

paper and is not a focus in and of itself. Perform a simple regression on GPR and the sentiment index for a macro view of the relationship. If we can find more granular data, perform event study to examine when do investors reach peak negative sentiment following a North Korean shock? How long does it take for this sentiment to recover?

Literature Review:

"Measuring Geopolitical Risk"- Dario Caldara & Matteo Iacoviello

The authors create a monthly index of geopolitical risk based on a tally of newspaper stories with terms related to geopolitical tensions. They analyze its evolution over time and effects since 1985. They note several periods that this index has spiked such as the Gulf War, 9/11, and the 2014 Russia-Ukraine crisis. They make three key findings: 1) Higher geopolitical risk leads to a decline in real activity and is associated with increases in the VIX and higher corporate credit spreads (2) higher geopolitical risk leads to lower stock returns (3) higher geopolitical risk leads to capital outflow from emerging economies toward advanced economies.

Several different companies track geopolitical risk in the form of indexes. These contain several shortcomings and are often qualitative and subjective. Often they consist of variables that react to instead of actually measuring geopolitical risk (e.g. gold, VIX). So they create an index that is constructed by counting the occurrence of words related to geopolitical tensions in leading international newspapers. They then study the relationship between this index and business cycles and financial markets movements. They also separate the index into two different

categories of geopolitical threats and geopolitical acts. They find that geopolitical threats has a much more powerful effect than acts.

They define geopolitical risk as "risk associated with wars, terrorist acts, and tensions between states that affect the normal course of domestic politics and international relations." Importantly, this definition centers around violence or potential violence. They calculate the index by counting the number of articles in major newspapers related to geopolitical risk for each month. The index has several advantages—available at a monthly frequency, separately measures risks and acts, a continuous measure, and directly measures the public perception of these event.

They examine the global macroeconomic effects of geopolitical risk by estimating a monthly VAR from 1985 to 2015, which includes a broad set of real and financial variables, such as the geopolitical risk index, VIX, and SP500 returns. The effect of geopolitical risk on stock returns is also examined with a simple regression model.

$r_{i,t} = \mu_i + \alpha_i GPRSHOCK_t + \varepsilon_{i,t}$

Where i indicates a country stocks returns in time t. They show that geopolitical shocks have a strong negative impact on stock returns in virtually all advanced economies.

The Price of Political Uncertainty – Bryan Kelly, Lubos Pastor, Pietro Veronesi

The authors empirically analyze the pricing of political uncertainty, using the theoretical model of government policy choice. To isolate political uncertainty, they exploit its variation around national elections and global summits. They find that political uncertainty is priced in the equity option market as predicted by theory. Options whose lives span political events tend to be more risky. They investigate whether and how the uncertainty associated with these events is priced into the option market. Options are good for this analysis because they have relatively short maturities which can cover the short duration of a political event. Since the political event is the main event that happens during the options life span. Also, options come with different strike prices, which allow the examination of various types of risk associated with political

events, such as tail risk. They use elections and summits because this is where you are most likely to see major policy shifts. Could this be applied to major geopolitical shocks and the options during these events? Major difference is that the political event dates are known in advance, while geopolitical shocks happen unpredictably.

The authors find that options are more expensive on average that exist during major political events than those that neighbor the time of these political events. The authors also identify the effect on prices during weak versus strong economic conditions. Possible application to geopolitical shocks—is there a difference in effect on pricing during strong versus weak economic conditions?

"News Sentiment and Investor Fear Gauge" – Lee Smales

The author studies the relationship between news sentiment and implied volatility as measured by VIX. They make several findings: (1) They find a negative contemporaneous relationship between changes in VIX and news sentiment (2) the relationship is asymmetric where changes in VIX are larger following the release of negative news items (3) the relationship between news and VIX is stronger in times of market turmoil.

They develop an aggregated index of firm specific news to test an empirical relationship with the implied volatility of an overall market index. Focus is to examine the relationship between unscheduled news events and changes in the VIX. Prior studies have shown that news that is highly relevant and novel induced a greater impact on asset prices. Uses Ravenpack's Multi-Classifier for Equities sentiment indicator. Applies this indicator to every firm in the SP500 to create an aggregate index.

Creates a simple OLS model where the change in VIX is explained by an intercept and a coefficient attached to the news sentiment at a given time. They find the intercept is not significantly different from 0 and a negative relationship with positive news sentiment (i.e. positive news results in a decrease in VIX while negative news results in an increase of VIX). They extend the model by separating positive and negative news sentiment into two different

variables. Notes that possible extensions of this study would be to develop effective trading strategies or apply to other asset classes.

"War and the World Economy: Stock Market Reactions to International Conflicts"- Schneider, Troeger (2006)

Examine the influence that political developments within three war regions had on global financial markets from 1990 to 2000. They show that the conflicts affected the interactions at the core financial markets in the Western world negatively. They note that there seems to be a disconnect between the effect of armed conflict on the real economy and its effect on financial markets. For example, markets usually drop initially after an armed conflict begins but quickly recover their losses, despite the well documented effect on the economy in the long run. So it seems that the armed conflict is not being properly priced in the financial markets. The demonstrate that the impact of political events on the financial markets depends on two factors: (1) the severity of conflictive events and (2) the degree to which economic agents could anticipate both cooperative and conflictive events.

They use on a GARCH (1,1) model to examine the dgree to which day to day trading in these stock markets reflects cooperative and conflictive events within three prominent conflicts: the confrontation between Iraq and the UN following the invasion of Kuwait, the conflict between Israel and the Palestinians, and the civil wars in Ex-Yugoslavia.

They show that the international markets do not generally respond to the ups and downs within these three conflicts. An increase in volatility is identified as a symptom of a market suffering from political uncertainty. They also find that positive and negative shocks have asymmetric effects, where negative shocks have a greater impact on volatility than positive shocks. Furthermore, they show that unexpected armed conflict unambiguously results in negative market reactions. They claim that conflictive events though that are anticipated can also have positive effects on the market since it lifts some of the uncertainty.

"Did Nordic countries recognize the gathering storm of World War II? Evidence from the bond markets"

They look at sudden shifts in yields on sovereign debt. Their results suggest that the Nordic countries did perceive an increased threat of war, despite common historian knowledge that they did not feel threatened until they were already invaded. The markets, specifically the bond market, shows that the market had viewed the setting as riskier.

"Does Geopolitical Risks Predict Stock Returns and Volatility of Leading Defense Companies? Evidence from a Nonparametric Approach" – Nicholas Apergis, Matteo Bonato, Ragan Gupta

Don't have access to this through UNC, but looks like it could be useful.

Further Literature

1. Blomberg, Hess, and Orphanides (2004)

Find that war and terrorism have an economically significant negative effect on growth, but the effect of terrorism is smaller and less persistent than that associated with wars.

2. Glick and Taylor (2010)

Large and persistent impacts of war on trade, national income, and global economic warfare.

3. Baker, Bloom, Davis (2013)

Effects of uncertainty on unemployment and investment.

4. Pástor and Veronesi (2013)

Uncertainty commands a risk premium and that stocks are more volatile and more correlated in times of high uncertainty. Could this be applied to geopolitical events? The geopolitical event is the uncertainty—will the threat materialize?

5. Fleming et al. (1995), Whaley (2000, 2009) and Giot (2005)

Find a significant negative and asymmetric contemporaneous relationship between stock returns and changes in implied volatility (VIX increases more as the SP500 falls than it decreases when the SP500 index rises)

6. Patell and Wolfson (1984) and Woodruff and Senchack (1988)

Look at scheduled news announcements that are firm specific. They find that most market adjustment occurs in the first 30 mins following corporate announcements.

7. Tetlock et al. (2008)

Find a quantitative measure of language can predict firm's earnings and stock returns

8. Smales (2012)

Finds that negative news has a larger impact on market activity than positive news.

9. Obstfeld and Rogoff (1996,25-7)

Show that the reactions of the global financial markets to the Russo-Japanese war were limited. They claim that traders were able to predict the winner of the conflict fairly easily

News Sentiment and VIX Relation

http://ac.els-cdn.com/S1544612313000354/1-s2.0-S1544612313000354-main.pdf?_tid=7abbb5f4-9c1c-11e7-90d7-00000aab0f01&acdnat=1505703359_01e01672f5adc65ec69a06ceef7226a7

https://www.gsb.stanford.edu/faculty-research/faculty/nicholas-bloom