Geo-Political Risk Indices and Their Influence on Financial Markets

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Disclaimer: This is not financial advice. All investments hold risk and if you would like to make investments please consult with a financial advisor first

Introduction

For the average Joe, the stock market is a fathomless endeavor. The mysteries of the market transcend all human understanding. However, for economists and financial professionals, the market is still complex but we can understand driving forces to the market. Why does a stock price increase in value or drop in value? Is it always company evaluation that drives stock price or are there outside forces at play?

Ever since the Ukraine-Russia war started in 2022, I have been ever fascinated by the military industrial complex. This idea that the economy is fueled by the war machine. On one hand I would think that is ridiculous, but on the other I would see my friends purchasing stocks from weapon manufacturers because they heard something online. A news article about some risk of conflict would bring these 20-something adults to buy shares with whatever money they could spare. That brought me to want to measure this phenomenon and find out whether this was an isolated event or whether this was having major implications on the market.

Background

Mutual Fund and Stocks

There is a mutual fund called iShares Dow Jones US Aerospace and Defense ETF. The ticker or short form of this mutual fund is ITA. Throughout the rest of this blog it will be referred to as ITA. A mutual fund is a collection of stocks put together and treated as one stock. This does a variety of things for the investor but in our case it does only one thing. This helps us track an industry instead of individual stocks. ITA does that by putting the top aerospace and defense companies into one fund and letting us track that price over time.

There is one problem with the mutual fund for our purposes. This is an easily solvable problem but a problem that has to be touched on. In statistical analysis the mutual fund can be dragged down by a company in the fund that is not related to the military industrial complex. For example, Boeng has been under the microscope lately because manufacturing integrity with civilian airplanes. This is why I am also going to analyze two stocks individually from the mutual fund that do not make civilian airplanes. That is Raytheon (RTX) and Lockheed Martin (LMT). I chose Lockheed Martin and Raytheon in particular because the product portfolio of both companies lend itself to being more exclusively weapons manufacturers for militaries.

Geopolitical Risk Index

War around the globe is a difficult thing to measure. Conflict has never stopped in all of human history. How to measure this went back and forth in my brain repeatedly. I ended up stumbling on the Geo-Political Risk index. This index is tracked by Dario Caldara and Matteo Lacoviello at the federal reserve board.

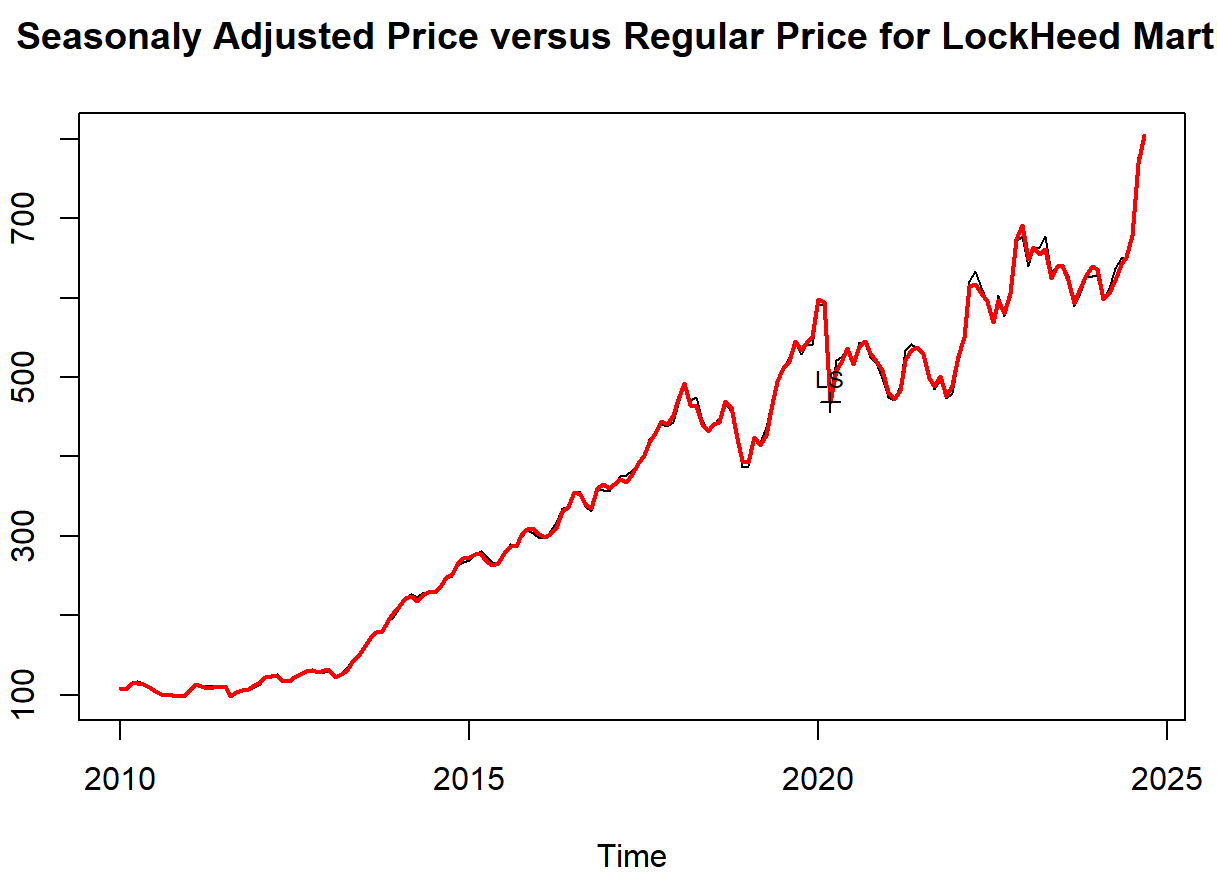
The Geo-Political Risk Index also known as GPR, tracks text searches from 10 newspapers. The newspapers being the Chicago Tribune, Daily Telegraph, Financial Times, The Globe and Mail, The Guardian, Los Angeles Times, The New York Times, USA Today, The Wall Street Journal, and The Washington Post. The searches are then catorgized into eight groups being war threats, peace threats, military buildups, nuclear threats, terror threats, beginning of War, escalation of War, and terror acts. The index spikes around major events like Cuban Missile Crisis, 9/11, and invasion of Iraq.

Methods

I had the index and the stocks I want picked out. The stocks being ITA, Raytheon, and Lockheed Martin. I also had the Geo-Political Risk index. I can't just use the raw data and compare means. I had to transform the data and pick a time frame I wanted to use. I used data from January 1st 2010 to December 31st 2023. The GPR index is a month to month index. I used the mean closing stock price of each month to be able to analyze it against the monthly index. Both series are time series data. I ran the augmented dickey fuller test and found that the GPR index is stationary around a mean. The stock price isn't stationary but I logged the data which helped eliminate the stochastic trend in the data. Logging the stock price data made the data Raytheon stock data stationary and the GPR index data is stationary meaning that we can regress them with confidence that the results will be accurate. The Lockheed Martin and the ITA data was not stationary even after the log. I had to do the difference of the first lagged variable for ITA and Lockheed Martin to make the data stationary. This was again checked using the Augmented Dickey Fuller test and all p-values were significant to at least a 0.02 level.

Adjusting Stock Price for Seaonalities and Inflation

Analyzing stock data comes with a set of problems. Mainly because it is time series data that is affected by seasons and inflation. These weren't difficult to solve but I thought it was an important point to let you know that the problems had been addressed. The stock price for ITA, RTX, and LMT were all inflation adjusted to December 31st 2023. This means that 2010 prices will reflect 2023 buying power. These three stocks are affected by seasonalities in the data. Government expenditure cycles play a large role in stock price. I adjusted for this by using a ARIMA13 model. Without going in to the weeds about how this works, it basically helped take out all the cycles in the data for me to be able to analyze the data overtime better.



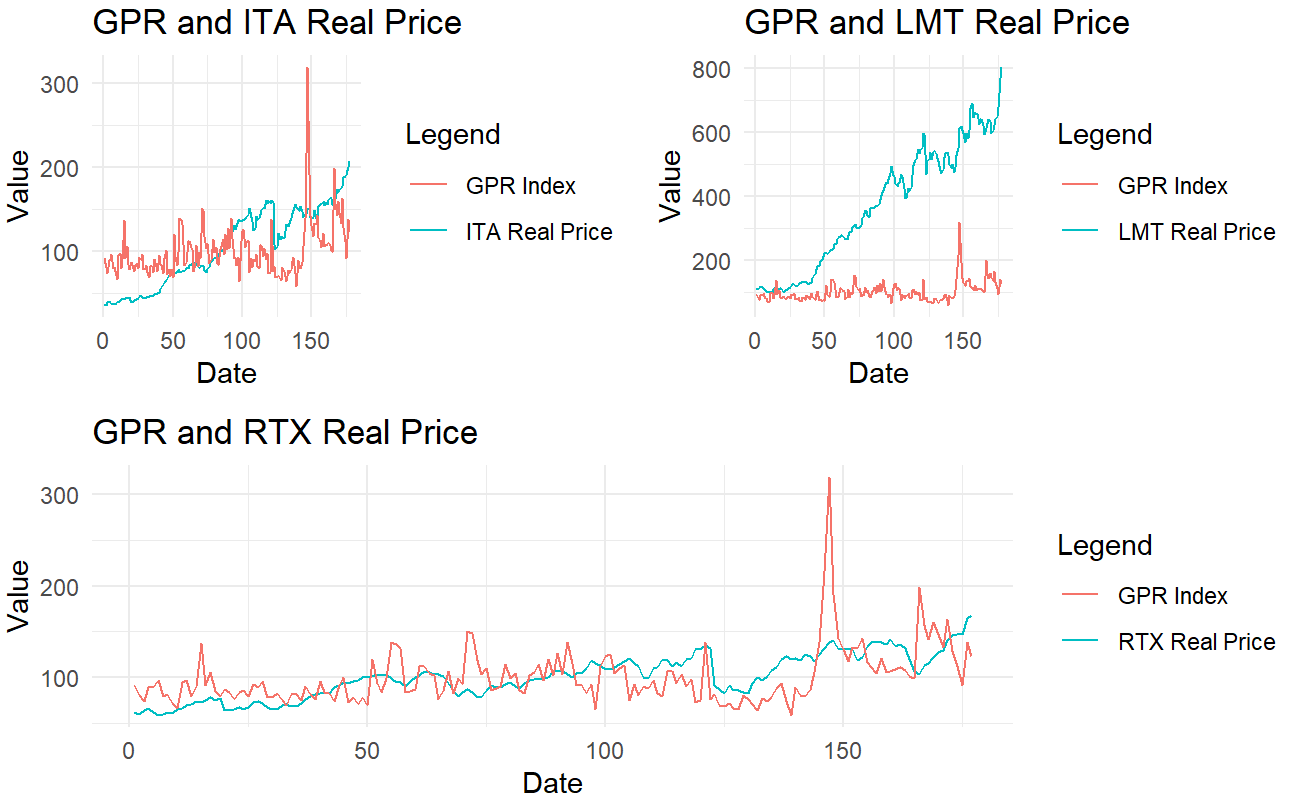
Statistical Analysis Set-up

The majority of my time was spent transforming the data into something I could work with. This is common with time series data. Once everything was set up to be able to be easily compared, I ran OLS Regression with my dependent variable being stock price and my independent variable being the GPR index.

Results

For Raytheon and Lockheed Martin, I got statistically significant positively correlated results with the geo-political risk index. The mutual fund did not show statistically significant results. I had a feeling this would happen due to the nature of mutual funds. However, I still wanted to run the regression and I think it is important to show. Even though the mutual fund stock price didn't show statistically significant results, I don't think that means that that is any less interesting. Arguably I think that is even more interesting in some aspects. The results lend a hand to the telling nature of how mutual funds work to shed risk from the investor.

All three real stock prices graphed against GPR Index



0 on the X-axis represents January 2010 and
every subsequent number represents months since January 2010.

Mutual Fund

The mutual fund was the least telling. As I said in the background, I knew this would likely be the case since there are other stocks in the fund that can eliminate the volatility and thus meaning smaller gains but lesser falls. This regression shows that the Geo-Political Risk index accounts for almost no change in the price of the mutual fund. There is a slight positive correlation but it is not statistically significant.

Regression of Log Difference Price of ITA on GPR Index

	Dependent variable:
	log(diffITA)
GPR	0.003 (0.002)
Constant	0.531** (0.244)
Observations	116
R^2	0.008
Adjusted R^2	-0.001
Residual Std. Error	0.994 (df = 114)
F Statistic	0.892 (df = 1; 114)
Note:	*p<0.1;* ***p<0.05;*** p<0.01

Raytheon

As mentioned before, Raytheon stands out as the only log price regression. The regression of Raytheon stock price from 2010 to the end of 2023 is similar to that other the other two regressions. The price of Raytheon stock is positively correlated to that of the Geo-Politcal Risk Index. According to the results, whenever there is a rise in 1% the value of the GPR index Raytheon stock would rise 50 basis point or roughly .5%. Our robust standard errors show that this has an error of roughly 6 basis points or .06%. The R square value is .195. This means that the change in the GPR index can account for 19.5% of the change in Raytheon stock. The results are significant to the 5% level.

Regression of Log Price of Raytheon Stock Price on GPR Index

	Dependent variable:
	log(RTX.Close)
log(GPR)	0.426*** (0.061)
Constant	2.295*** (0.282)
Observations	177
R^2	0.195
Adjusted R^2	0.190
Residual Std. Error	0.221 (df = 175)
F Statistic	42.288*** (df = 1; 175)
Note:	*p<0.1;* ***p<0.05;*** p<0.01

Lockheed Martin

Similar to the ITA index, Lockheed Martin was the log of differences regressed against the GPR index. The regression showed that with an increase in the GPR index by 1% there would be a 1.15% increase in Lockheed Martins stock price. The robust standard errors being .35% either more or less. This is equivalent to around 115 basis points for every 1% increase in the Geo-political risk. This shows that the two time-series are positively correlated with one another. The R squared value shows that the GPR index can make up for about 6% of the total change in Lockheed Martins stock price. That is almost 14% lower than that of Raytheons but within a similar range. This is all significant to the 5% level.

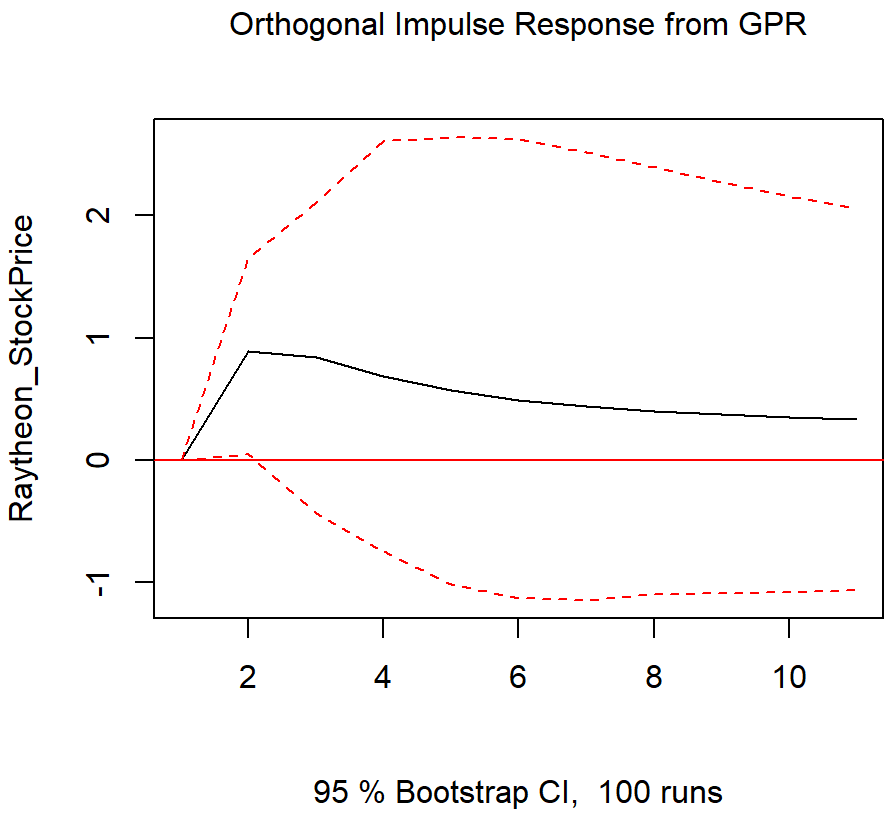
Regression of Log Difference Price of Lockheed Martin Stock Price on GPR Index

	Dependent variable:
	log(diffLMT)
log(GPR)	1.152*** (0.351)
Constant	-3.258** (1.627)
Observations	115
R^2	0.066
Adjusted R^2	0.058
Residual Std. Error	1.188 (df = 113)
F Statistic	7.963*** (df = 1; 113)
Note:	*p<0.1;* ***p<0.05;*** p<0.01

Impulse Response Function

I wanted to better understand how these data series interacted with each other. The best way I thought to do that was run an impulse response function. An impulse response function can provide a one standard deviation shock to the data and see the response of another variable. In my case I used a shock of the Geo-Political Risk index and the response was the Lockheed Martin and Raytheon stock. I chose not to include the mutual fund in this result because the regression above showed that the two were uncorrelated.

I first had to run a Granger causality test to determine predictive causality. Can the GPR index predict stock price essentially. I received significant results that the GPR index has predictive causality to LMT and RTX stock price. I then graphed the response of both impulse reaction functions.


Orthogonal Impulse Response from GPR
Raytheon_StockPrice
2
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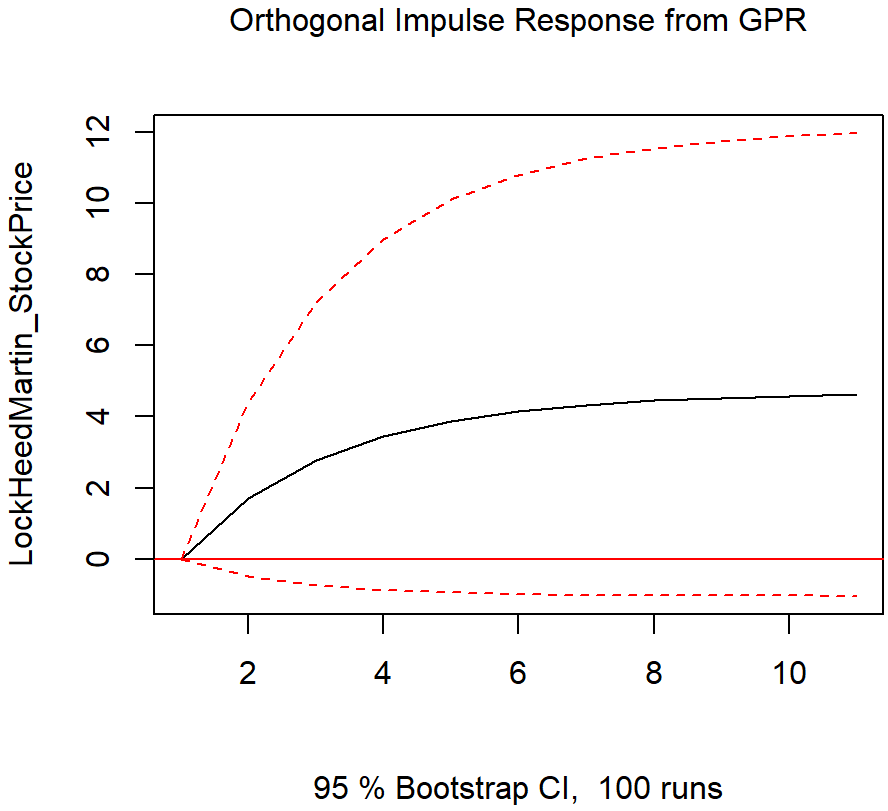
95 % Bootstrap CI, 100 runs


Orthogonal Impulse Response from GPR
LockHeedMartin_StockPrice
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95 % Bootstrap CI, 100 runs

The above graphs show two things I think are interesting. The first is that a shock to the GPR index results in an increase in stock price for both companies. Another thing I find interesting is that those shocks are permanent. When the shock disappates, the stock price remains at its new found level.

Conclusion

What does this mean? Does this mean that the stock price is caused by the Geo-political Risk index? No that couldn't be farther from the truth. The point of doing this analysis was to see if newspaper headlines could influence stock price. I believe the answer to be yes. That yes does not come without reservation. Stock price can be influenced by a multitude of things and many of those variables were left out in this analysis. Clearly newspaper headlines aren't the whole story. If management at Raytheon can't balance a budget, then it doesn't matter how much conflict there is it wouldn't save Raytheon from bankruptcy.

As I said in the introduction about my friends buying stocks based on the news articles, I believe this is culture changing the financial landscape. As we sit now, it is easier than ever to trade stocks. The barrier to entry in the stock market is lower than ever with brokerages like Robinhood. I think this analysis over the last ten years of newspapers headlines and stock price shows that the common man has more influence in the stock market than maybe realized. I alone can't move stock prices like big hedge funds with billions of dollars. However, a few decades ago those funds were the only participators in the market. That landscape is changing. This could be for the better or for the worse. I can only theorize that as the common man makes up more and more of the market share, that can only make the market more volatile. Hedge funds have to be smart and tactile to stay in business. However, my friends in undergrad can make extremely rash decisions with their thousand dollars and still stay financially afloat. You multiple that over thousands of people that might mean that newspapers can increasingly affect stock price.

Currently, the regression analysis of the last ten years of closing price show that these few stocks can account for 6% to 20% of the change in stock price from newspaper headlines that were measured by the Geo-Political Risk index. That is 25 cents to 1 dollar for every 5 dollars in change in stock price. That can havel large implications. I don't want to put on my tin-fole hat too much but if a morally grey person were about to sell shares and they knew that running some newspaper headlines could possibly let them sell shares for a higher price then they just might do that. This can have important implications into the law which in theory this is protected by the law. The most important take away from this is to understand is that there are unseen financial incentives in our daily life. It is always important to check sources and facts and properly decipher information.