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Bachelor's Thesis Financial Economics

Assessing Geopolitical Risk as a Factor in Asset Pricing

A modified CAPM analysis of NASDAQ-100 stocks

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Abstract

This paper examines the possibilities of using the geopolitical risk index developed by Caldera and Iacoviello in asset pricing, with a special dive into the technology sector to examine the effect of the so called 'Tech war' tensions on technology stock prices. The index is included as an independent variable to determine its coefficient on a technology portfolio as well as on a market portfolio, including the Fama/French Three-Factor model. Data included is from summer 2014 through summer 2022. The results are found using ordinary least squares, resulting in a model where geopolitical risk can be used to predict stock prices to some extent. However, his paper found no evidence that including geopolitical risk in asset pricing results in better price predictions than using the Fama/French Three-Factor model. This means that current asset pricing models maintain their top tier and that geopolitical risk should be left out of the equation until further research.

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1. Introduction

The past years, especially when President Donald Trump was elected, a lot of distortion has happened in Big Tech. The President was aware of dangers that could become if China were to surpass the United States of America on technological development. This had led to the United States blocking multiple Chinese technologies, standing in the way of exports and imports, and even pressing other countries to do the same (Lobosco, 2022). The United Stated of America are trying to convince tech giant ASML to stop delivering their chip-manufacturing machines to Chinese companies to prevent them from further development, they are doing everything to prevent China from annexing Taiwan as it is the world's largest chip developer (Toh, 2023), and they are even trying to ban the Chinese social medium TikTok (Thorbecke & Fung, 2023).

Whatever one's opinion can be concerning all these measures, one thing every investor suffers due to these measures is an increase in uncertainty among businesses. If ASML were to be banned from delivering chips to the country containing almost a quarter of the world's population, what will the effects be on their business. Other companies in Big Tech might face the same problems as tension continues to rise, which will bring concerns among investors. Therefore, society is better off prepared with an investment strategy that approximates a model mapping the geopolitical risks and their effects on share prices. Large firms are known to use the capital asset pricing model as their primary model for making investment choices (Graham & Harvey, 2001), which gives reason to develop a strategy using this model. Wang, Wu & Xu (2019) also discovered that there is a strong negative relationship between an increase in geopolitical risk and firm-level investing. Lastly, it is also known that commodities, especially gold, tends to increase in value as geopolitical risks increase (Baur & Smales, 2018). Those papers hint that there is a lot of unchartered territory regarding geopolitical risks and investing. However, none of those papers have used the geopolitical risk index developed by Caldera & Iacoviello (2022) to develop an investment strategy. Hence, the research question is:

"What is the relation between geopolitical risks and technology stocks and to what degree can the capital asset pricing model be utilized as an investment strategy that considers these risks?"

This paper will examine the effect of geopolitical risks on share prices of Big Tech companies, namely the NASDAQ-100 indexed companies, and develop an investment strategy based on the capital asset pricing model. The purpose of this paper lies in the enhancement of preparation on possible and likely further measures by the United States of America on trade with China.

Caldara and Iacoviello (2022) developed a method to measure and quantify geopolitical risks. Due to the groundbreaking index, geopolitical risks can now be regressed on other variables. The scientific relevance of this paper comes down to the absence of investment research on geopolitical risks while global concerns grow. Especially stakeholders of Big Tech companies need clarification. Alqahtani et

al. (2022) have researched the correlations between geopolitical risks and the economy in the Middle East and Northern Africa, but no further research has been done on this matter.

This study will be performed using the forementioned data from the current NASDAQ-100 portfolio. As the NASDAQ-100 portfolio changes yearly, taking the current selection of companies is the most relevant as taking the individual yearly portfolios allows no regressions to be performed. The data will be retrieved using Wharton Research Data Services (WRDS). This monthly stock return data will be checked on correlation with the geopolitical risk index, also using monthly data, from the year 2014 until the end of 2022. This correlation will help in deciding whether geopolitical risk would be a valid metric in a capital asset pricing model (CAPM). For the CAPM to be successfully executed, this paper also requires a definition of the market risk premium. To determine the market risk premium, data will be retrieved from the S&P500, as this is generally considered the best proxy for the market portfolio (Berk & DeMarzo, 2016). The average market return will be calculated from 2014 until 2022. The risk-free rate will be determined using the average 10-year US Treasury Bond yield.

The expected results of this paper are dependent on the findings of the data analysis. If the linear regression analysis shows a statistically significant and positive correlation between stock prices and quantified geopolitical risk, this would suggest that investors are pricing geopolitical risk into their investment decisions, and that the perception of risk can affect the value of stocks. This finding would be consistent with previous research in the field.

If the application of the CAPM shows that the systematic risk of the sample companies is significantly affected by geopolitical risk, this would provide further evidence of the impact of geopolitical risk on financial markets. Moreover, if the market risk premium increases in times of heightened geopolitical risk, this would suggest that investors demand a higher return on their investment in response to increased risk.

Overall, the results of this paper may have implications for investors, businesses and policymakers. Investors may use the findings to inform their investment decisions and risk management strategies. Businesses may use the findings to assess the impact of geopolitical risk on their operations and financial performance. Policymakers may use the findings to develop policies aimed at reducing the impact of geopolitical risk on financial markets and promoting stability in the global economy.

The remainder of this paper will start with an elaborate literature review (*Chapter 2)* where the scientific foundation for this research is set out, alongside the definition of the hypotheses. After the literature review, a glance is taken at the data used to answer the research question, including explanations of the data as well as descriptive statistics (*Chapter 3)*. Once the data is clearly defined, the methodology will be explained (*Chapter 4*) after which the results of the data using the methodology will be exhibited, reviewed and discussed (*Chapter 5*). Lastly, this paper will include a conclusion (*Chapter 7*).

2. Literature review

2.1. Stock return & Capital Asset Pricing Model

In the context of stock returns, "return" refers to the financial gain or loss on an investment in a particular stock over a specific period of time, in this paper this relates to monthly data. It quantifies the change in the value of the investment, expressed as a percentage or a decimal, and reflects the profit or loss generated from holding the stock. More precisely, the return on a stock investment is calculated by comparing the ending value of the investment (including dividends or other distributions received) to its initial cost or basis.

Stock returns are an efficient measure of risk and reward in the market. Investors require returns for setting their money aside and risking it. In the efficient market hypothesis, stock prices reflect all the available information regarding firms, which makes the returns a suitable outcome variable when trying to measure correlations with other variables (Yen & Lee, 2008).

The Capital Asset Pricing Model (CAPM) uses stock returns as one of the main factors. The model is a widely used financial model that provides insights into the relationship between risk and expected returns for an investment. The CAPM is important because it offers a systematic framework to estimate the expected return of an investment and plays a vital role in asset pricing and portfolio management. the CAPM serves as a foundation for other asset pricing models and provides insights into the pricing of risky securities. It has also been influential in portfolio management theory, guiding asset allocation decisions and helping investors construct diversified portfolios that balance risk and return. The CAPM allows for extensions using other variables.

Fama & French (1992) introduced the Fama/French three-factor model as an extension of the CAPM, incorporating size and book-to-market ratio as additional factors. By including these factors, the Fama/French model provides a better understanding of asset pricing. The size factor accounts for the size effect, where smaller companies tend to exhibit higher expected returns even after adjusting for market risk. Meanwhile, the book-to-market factor captures the value versus growth investing styles, with higher book-to-market ratios associated with higher expected returns. Incorporating these factors improves the model's explanatory power, capturing additional systematic risks and enabling a more accurate estimation of expected returns, particularly in diversified portfolios. The inclusion of Fama/French factors enhances the practical applicability of the CAPM in portfolio management and investment decision-making.

2.2. Geopolitical risk and its relationship to returns

For this study to be completed, a precise formulation of geopolitical risk must be defined. As the geopolitical risk index by Caldera and Iacoviello is used answering the research question, the definition will be extracted from their research. Geopolitical risk is defined in this paper as "the threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations" (Caldera & Iacoviello, 2022, p.2). This definition includes power struggles that do not involve acts of violence and competition over territories. It also captures a wide range of adverse geopolitical events, from their threat to their realization to their escalation. The definition is quite fitting considering the Cambridge Dictionary's definition of geopolitical "connected with political activity as influenced by the physical features of a country or area, or with the study of the way a country's size, position, etc. influence its power and its relationships with other countries" combined with risk "the possibility of something bad happening".

One of the first papers examining market returns factoring in geopolitical risk was done by Diamonte, Liew & Stevens (1996). They found a significant correlation between returns and a relatively high geopolitical risk. They also discovered that changes in political risk have bigger impact in emerging economies than in developed markets. So, when for instance the USA has a new unpopular president, the effect on investments in the USA will be smaller than the effects when a Central-African nation obtains a new unpopular president. Important to mention is that the researchers concluded that geopolitical risk cannot be quantified, but should be qualitatively assessed. It is also known that firm-level investments have a strong correlation with geopolitical risk (Wheeler & Mody, 1992). Political change, chance of terrorism, corruption labor stability, each correlated with each other, cause the openness to international investing to decline. Karolyi (2006) tried to measure the effects of terroristic threats and acts on financial markets. He found that the threats increase risk aversion among investors, but they lacked data to really do a quantitative approach. What Barkoulas, Quinn and Santos (2008) found, is that hedge funds try to hedge against geopolitical risk by selling or shorting transport industry stocks, insurance companies and retail, whilst buying and going long in industries such as gold mining, energy, telecommunications and biotechnology.

Hassan et al (2019) discovered that political risk definitely influences firm valuation. The effects differed across firms, sectors and countries. Especially firms depending on government contracts and firms operating in countries with high political polarization tend to devalue when geopolitical risk increases.

The most influential paper was recently published by Caldera and Iacoviello (2022), as they created the forementioned geopolitical risk index. Using insights from Gentskow, Kelly & Taddy (2019) regarding quantifying text, they were able to create an algorithm that analyses newspapers daily and scans for

words indicating an increase in geopolitical risk. Caldera and Iacoviello have been cited over a thousand times since their publication, which makes their index a credible source.

This paper focusses on tech stock returns as technology companies undergo increasing geopolitical vulnerability. Kumar & Tusu (2023) said that especially digital platforms, like TikTok, are highly vulnerable to international relations. This was due to the banning of the platform in India, whilst the platform itself is highly popular. This indicates that a classical valuation of the platform would estimate a lot higher value than when geopolitics are factored in, as over a billion world citizens have been deprived of the social medium. The same counts for Huawei, a tech company that has caught fire due to allegations of conspiring with the Chinese government. Because of the allegations, the progress to implementing 5G halted globally (Hoffman, Bradshaw & Taylor, 2019).

Another aspect to consider is that, according to Khan et al. (2022), technological advance in a certain country generally increases international tension and competition, meaning geopolitical risk, because nations want to be the most dominant. This way, the relationship between geopolitical risk and the return on investment for technology stocks might restrict trade but still increase returns due to sovereign stimulation.

The expectations of this paper are that the effects of political tension, leading to market restrictions and therefore growth restrictions for companies, affect stock returns for companies negatively. For an investor, it is useful to know what to pay attention to when political tensions increase. Now that tension is increasing due to technology advancements in third-world countries, investors should be well prepared when real measures are taken by governments. Therefore, this paper test whether there is a relationship among stock returns and geopolitical risk. Also, this paper will control for the relative vulnerability of technology stocks compared to the overall market, for which the S&P500 is used (Berk & DeMarzo, 2016), so an investor might know where to put its priority. For these reasons, the first hypothesis is:

H1: *There is a negative relationship among stock returns and geopolitical risk and the technology industry has an increased risk compared the overall market*

The hypothesis leads to the expectation where a high geopolitical risk would have a negative impact on the revenue and therefore the stock price.

Secondly, as the expected result for the first hypothesis is a negative correlation among stock return and geopolitical risk, is that it is possible to develop an investment model based on the data. A modified capital asset pricing model will be used to try to enhance the predictability of the stock returns. Factoring in size and book-to-market ratio has proven to be a beneficiary addition to the Capital Asset Pricing Model. This paper is curious whether the addition of geopolitical risk will also prove to be beneficiary and should be included in an investor's decision making. Hence, the second hypothesis is:

H2: *The observed effect of geopolitical risk is robust to incorporating the Fama/French Three-Factor CAPM into the model*

By answering the two hypotheses using a quantitative approach, it will be possible to answer the research question and determine whether geopolitical risk is an important variable to include when investment options are considered.

3. Data

3.1. Sample description

The collected data is a merger of three datasets. The first database provided this research with the data on geopolitical risk, which was downloaded from the website created by Iacoviello & Caldera. The dataset includes the global GPR index. The second dataset was collected from Wharton Research Data Services, following their access to the CRSP/Compustat merged dataset. In this portal, monthly data could be accessed on all known NASDAQ-100 tickers. The NASDAQ-100 portfolio contains technology companies, forming the Tech Stock portfolio used in this study. The third dataset containing control variables is imported from the Fama/French website for research purposes. The research done in this paper is performed using 7358 observations, that includes 96 observations per company for most companies. Nine out of the hundred companies had fewer, accounting for the missing observations. Those 96 observations include all monthly date stamps from June 2014 until May 2022. The datasets were merged based off a mutated data format for compatibility. The dataset also includes all monthly stock returns, number of shares outstanding, volume, open- and closing prices and the country the corresponding enterprise's headquarters are settled.

3.2. Variables

The dependent variable in this paper is *Return*, the variable represents the month on month return for all individual stocks in the NASDAQ-100 portfolio. The calculation of *Return* is done by taking *Pclose*, the closing price at the end of the *month* at time *t*, subtract the *Pclose* at time *t*-1 and divide it by *Pclose* at time *t*-1, where "*t*-1" means the prior month. In the seven years observed, *Return* is quite constant, and *Pclose* is gradually, but slowly, rising. The corresponding equation for *Return* is

$$Return = \frac{Pclose_t - Pclose_{t-1}}{Pclose_{t-1}} \qquad (1)$$

The independent variable during this study is *GPR*, short for *Geopolitical Risk* (the abbreviation will be used to prevent long equations). The independent variable is an indicator of the severity of tension around the globe. The variable is measured using the frequency at which geopolitical events are mentioned in newspapers, it does so by automatically analyzing ten different newspapers for words typically used in adverse circumstances. *GPR*'s value is 100 during average times. When the world is doing well and few distortions are around, it drops below 100. When more articles are published describing global tension, it rises above 100. *GPR* generally circles around it's base value 100, but in smaller time intervals it tends to auto-regress. High values are found on dates where severe events happened, especially during the first quarter of 2022 when Russia sent military units to Ukraine.

The control variables collected are *SMB, HML* and R_f. These are the independent variables used to perform the modified CAPM equation, collected at the Fama/French website for research data. *SMB* is short for Small Minus Big, a variable that is formed by creating multiple portfolios of small and big companies, taking their return, and calculating the average difference of the portfolios. *HML* is the abbreviation for High Minus Low, considering Book-to-Market portfolios of companies with a high Book-to-Market ratio and portfolios with low Book-to-Market ratio companies. Just like *SMB*, the returns of the first are subtracted from the latter, and afterwards the average of the differences is taken from the many different portfolios. R_f is the variable for the risk-free rate, and circles around naught. Furthermore, the S&P500 (*SP500*) is included as market proxy, including the 500 largest companies in the United States of America. To create a variable for the market risk premium, used in the CAPM, *SP500* is subtracted with R_f, generating the variable *RiskPremium*. Corresponding equation for *RiskPremium* is

$$RiskPremium = SP500 - R_f \qquad (2)$$

3.3. Descriptive statistics

The descriptive statistics for the data used in this paper are shown in Table 1. The table contains the mean, standard deviation, minimum and maximum observed values of the variables. No outliers are observed in the sample, the sample also gives no reason to believe there is skewness.

	mean	sd	min	max
Return	1.79	9.43	-49	126
Geopolitical Risk	101.24	34.82	61	326
Small minus Big	-0.08	2.70	-6	7
High minus Low	-0.11	3.71	-14	13
RiskPremium	0.84	4.17	-13	13
R_f	0.06	0.07	0	0
Observations	7358			

Table 1 – Descriptive statistics

4. Methodology

The statistical analyses in this study are performed using STATA software. The regressions are performed using Ordinary Least Squares (OLS), where no corrections for heteroskedasticity are made as the data is homoscedastic.

To answer the first hypothesis, *Return* will be regressed against *GPR*. However, as the goal is to also determine whether the technology sector reacts worse to geopolitical risk than the overall market, the S&P 500 is included. First, to test whether there is a relation, *Return* and *GPR* are equated. This leads to equation

$$Return = \beta_1 * GPR \qquad (3)$$

Next, the relationship among *SP500* and *GPR* must be tested. Therefore, equation (1) will be copied, but *SP500* will substitute *Return* as dependent variable. This results in equation

$$SP500 = \beta_2 * GPR \qquad (4)$$

Lastly, it will be checked whether the difference between the coefficients is significantly different using null-hypothesis

$$H_0: \beta_1 - \beta_2 = 0 \qquad (5)$$

If the null-hypothesis is rejected, it can be concluded that the technology sector has increased exposure to geopolitical risk compared to the market portfolio. Note that the betas (β_i) represent the coefficients of the variables.

For the modified CAPM analysis, the Fama/French factors are included. The Capital Asset Pricing model has the base formula where the expected result is a function of the risk-free rate (R_f) , the market risk premium (*RiskPremium*) and the β that represents the coefficient for the vulnerability, or rather a multiplier to how a stock or portfolio reacts on movements by the market. When adding this to the first model, this leads to model two with equation

$$Return = \Upsilon * GPR + R_f + \beta_i \, RiskPremium \qquad (6)$$

Where *Return* is the expected return, β_i is the beta of the investment, *RiskPremium* is the market risk premium and R_f is the risk-free rate.

To factor in the Fama/French factors, *SMB* and *HML* are added to the equation. Recall that *SMB* is a variable for the size portfolio returns, where the returns from a small size company portfolio are

deducted with the returns from a large sized company before they are averaged out. mathematically the equation for *SMB* is as follows:

$$SMB = (1/N) * \sum (R_s - R_b) \qquad (7)$$

Where N is the number of portfolios analyzed, R_s accounts for returns of small companies, R_b accounts for the returns for big companies.

HML on the other hand represents the Book-to-Market portfolio returns. The equation is similar to that of *SMB*, only that R_s and R_b are substituted for R_h and R_l. The two represent the return of a high, respectively low, book-to-market stock portfolio; leading to equation:

$$HML = (1/N) * \sum (R_h - R_l) \qquad (8)$$

Both *SMB* and *HML* will have a corresponding coefficient that will indicate the variables' contribution to the expected return.

HML and *SMB* will be added to the equation both separately as model three and four, as well as together forming the full model. When all three Fama/French CAPM factors are included in the model, meaning *RiskPremium, SMB and HML,* the final equation is as follows.

$$Return = R_f + \beta_m\, RiskPremium + \Upsilon * GPR + \beta_s * SMB + \beta_h * HML \qquad (9)$$

Next, the collected data will be used to execute the methodology, upon which results will be evaluated. R_f will be represented in the constant in the regression.

5. Results

5.1. Hypothesis 1

For the first hypothesis, the results are shown in Table 2. The table should be interpreted in a sense where *Return* and *SP500* are the dependent variables in two different regressions, upon which a coefficient from independent variable *Geopolitical Risk* is measured. To its right, the coefficient can be read, beneath it is the standard deviation, sandwiched by parentheses. The constant should not be interpreted. However, the coefficient for *Geopolitical Risk* can be interpreted in a manner that for every *Geopolitical Risk* point increase, the return (in percentages) decreases. Mind that *Geopolitical Risk* is a variable with value 100 in "neutral" times. The significance can be interpreted by the number of stars next to the numbers in the table. All the numbers include three stars, indicating a p-value of smaller than 0.01.

	(1) Return
Return	
Geopolitical Risk	-0.03***
	(0.00)
Constant	4.74***
	(0.34)
SP500	
Geopolitical Risk	-0.02***
	(0.00)
Constant	2.76***
	(0.15)
Observations	7351
R^2	0.01
Adjusted R^2	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2 – Return and Market proxy as a function of Geopolitical Risk. *Note: on the left side of the table the variable name is displayed, on the right the model results is displayed. The numbers represent the coefficient of the variable. The numbers in parentheses represent the standard deviation of the coefficient. The number of stars next to the coefficient measure the significance of the coefficient, in this table, all coefficients are significant with a p-value smaller than 0.01.*

The results in the table are clear as they are very significant. What can be observed is that both *Return* and *SP500* are significantly correlated with *Geopolitical Risk*, and that an effect is there. From the sample, it seems that for every *Geopolitical Risk* point increase, *Return* drops by 0.03, respectively 0.02 percentage-points. Due to the scale of *Geopolitical Risk*, it is easier to interpret it in a manner where 100 extra *Geopolitical Risk* points equal a 3% stock price drop. The model has an R-squared of mere 0.1,

meaning approximately 10% of the variation can be explained by the variables in this model, so the overall fit is not very high.

When testing the difference between the effect of *Geopolitical Risk* on *Return*, meaning the technology stocks portfolio, and *SP500*, meaning the market portfolio, no difference can be concluded. The term was significant, $F(1,14698) = 15.01$, $p < 0.01$. This means that when the coefficients are subtracted from one another, no significant difference from zero can be interpreted. The null-hypothesis cannot be rejected meaning it cannot be stated that the coefficients differ substantially outside of the sample.

To answer the first hypothesis, geopolitical risk is an explanatory variable for stock returns. Although no causal relationship can be concluded, it is clear the two are related. However, it cannot be stated that technology stocks have higher or lower exposure to geopolitical risk than other stocks. Therefore, the remainder of the results can only conclude about the general market, rather than technology stocks.

5.2. Hypothesis 2

Hypothesis two accounts for the question in what way geopolitical risk can be used for investment decisions, by addressing the world-renowned and vastly used Capital Asset Pricing Model. Especially using the Fama/French Three-factor model that is used by financiers these days a real-world conclusion can be formulated for integrating geopolitical risk in investment decisions.

Table 3 shows the regression results of the different models described in the methodology section. The results should again be interpreted in a manner where the coefficient is the amount of change in percentage of return described by the variable. On top, five models can be observed, each of which includes different variables. Model 5 includes all variables and represents the full model. In parentheses, the standard deviation can be found. The significance is measured in stars next to the coefficient. One star means a p-value smaller than 0.1, two stars equals smaller than 0.05 and three stars equals smaller than 0.01. The more stars the coefficient shows, the more significant and reliable the variable is.

	(1) Return	(2) Return	(3) Return	(4) Return	(5) Return
Geopolitical Risk	-0.01***	-0.03***	-0.02***	-0.02***	-0.01*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
RiskPremium	1.08***				1.05***
	(0.02)				(0.02)
High minus Low		-0.24***		-0.27***	-0.27***
		(0.03)		(0.03)	(0.03)
Small minus Big			0.52***	0.55***	0.20***
			(0.04)	(0.04)	(0.04)
Constant	1.85***	4.48***	4.25***	3.92***	1.43***
	(0.30)	(0.34)	(0.33)	(0.33)	(0.30)
Observations	7351	7351	7351	7351	7351
R^2	0.23	0.02	0.03	0.04	0.25
Adjusted R^2	0.23	0.02	0.03	0.04	0.25

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3 – Regression results *Note: This table contains the different models numbered from 1 to 5 on top, and all the variables are displayed on the left. All the models represent Ordinary Least Squares regressions, with coefficients and a constant on the bottom. If the model has a number at a certain height, it means the corresponding variable on the left side of the table is included. The numbers represent the regression coefficient, accompanied by a number of stars that represent the significance (see beneath the table for a guide on the stars). The numbers between parentheses display the standard deviation of the coefficient. The R-squared displays how explanatory the model is for the variation in the dependent variable (Return), the closer it is to 1 the more fitting it is.*

What can be seen in Table 3 is that *Geopolitical Risk* and *HML* have negative coefficients, in line with expectations. *HML* having a negative coefficient indicated that growth stocks are outperforming the value stocks. The coefficient of *RiskPremium*, which is the market beta, is also positive. This was expected as technology stocks are expected to move more than the market. *SMB* also has a positive coefficient, indicating small companies are outperforming large companies. So, all the variables included in the models have the expected signs and do not change as variables are added.

The R-squared of the models is the highest for the fifth model, where 25% of the variance in *Return* is explained by the independent variables included. It seems that most of this increase in R-squared comes from including *RiskPremium*, which is not very strange as this is the market return proxy and several of the companies included in the tech-portfolio are also represented in the market portfolio.

The variable of interest is *Geopolitical Risk*, which is also the most interesting variable to observe. What can be seen from the results is that, compared to the very first model used for hypothesis 1, the coefficient slightly degrades as other variables are added to the model. In model 1 of Table 3, most of its effect is already absorbed by the market proxy; at least variable is still significant at this point. On top of that, when including the other variables, in model 5, the significance drops to one star with a p-

value smaller than 0.10, but higher than 0.05. Considering there are 7.351 observations, and combining this with a low coefficient, the variable becomes rather irrelevant.

To answer the hypothesis, Geopolitical Risk is not robust to the widely used Fama/French Three-factor CAPM model, and is better left out of the equation when making investment decisions.

5.3. Discussion

Although geopolitical risk can be used to predict stock prices on its own, this study has found this strategy would not beat the Capital Asset Pricing Model due to the latter's superior explanatory power. One of the key reasons to believe this is the case, has to do with the overall market. A rule of thumb for asset pricing is that all the variables in the world are represented in the amount of money someone is willing to pay for an asset. This comes down to whether it is a sunny or rainy day to a declaration of war or a peace treaty, and everything in between. This leads to the presumption that geopolitical risk is already represented in market prices, especially when using monthly data. Perhaps, if the geopolitical risk index was updated hourly, the explanatory power would greatly increase. This could perhaps serve as a predictor for declines in stock prices, in the way analysts read different newspapers every day. The geopolitical risk index would then serve as a tool to know when tensions around the world increase without the necessity to read or watch the news. For now, this paper concludes somewhat the same as previous researchers concluded. Diamonte, Liew & Stevens (1996) and Karolyi (2006) already concluded there certainly is a correlation and perhaps even a causality in asset pricing and geopolitical risk, but did not have enough data to quantify it into an investment strategy.

Limitations in this paper include the limitation to the technology sector. The technology sector seemed relevant to focus on due to reasons mentioned in the introduction. With the banning of certain platforms in countries and the importance of technology in the modern world this seemed an interesting sector to specify. However, as the technology sector did not seem to have more exposure to geopolitical risk than the overall market, probably because the banning of for instance TikTok did not add that much to the geopolitical risk index, it might still be worth researching other sectors. It could also be interesting to create a portfolio where different countries are more equally represented. As the portfolio used in this paper was represented by companies in the United States of America for more than three quarters, it might seem logical that the banning of a Chinese company in India does not affect stock prices, but may increase geopolitical tension.

6. Conclusion

This paper reviewed the possibilities of combining geopolitical risk and asset pricing as a result of the development of the first quantified geopolitical risk index. The purpose of this paper was to explore to what extent geopolitical risk can be utilized as a variable in investment decisions. As investors try to include all available information when deciding on what will be the most profitable place to put their money, it is crucial to explore new possibilities. For this reason, the research question in this paper was "What is the relation between geopolitical risks and technology stocks and to what degree can the capital asset pricing model be utilized as an investment strategy that considers these risks?"

To answer the research question, data has been collected on stock prices, geopolitical risk and several other variables to perform multiple ordinary least squares regressions. Geopolitical risk in investment decisions has been regressed and tested for robustness in the capital asset pricing model. Although geopolitical risk is a predictor of stock prices, it is not as useful as already existing, renowned asset pricing models.

The conclusion of this study is therefore that it cannot be stated that geopolitical risk is an important factor in investment decision making. There might be different results when including different data or when observing a different time span, but at this point no conclusions can be drawn from that. Combined with the results from previous studies this paper again concludes that including geopolitical risk, even after the publication of the index, is a tough measure to include in investment models.

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