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CAPM Beta and Geopolitical Risk

Excess Returns with Geopolitical Black Swan Investing on the EURO STOXX 50 Index

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Abstract

Recent years, geopolitical risks have dominated the news feed for the financial markets. There have historically been some geopolitical events that have resulted in major declines in the stock market and such a market day can be classified as a geopolitical Black Swan. The purpose of this essay is to investigate the area of CAPM beta and geopolitical risk where the main investigation is if beta is a useful tool for portfolio selection by taking advantage of negative geopolitical Black Swans. Additionally, this research investigates whether high-beta portfolios decline more than low-beta portfolios when the market falls significantly due to a geopolitical event. EURO STOXX 50 index is chosen as the survey index. Based on the findings of the study, it seems that beta is a good risk measure for geopolitical risk, at least for large and unexpected market declines due to geopolitical risk. This study also found that beta appears to be a useful tool for portfolio selection at least in terms of identifying portfolios that increase more than the market after a negative geopolitical Black Swan and decline less than the market after the following positive Black Swan. The results of this study also seem to show that the phenomenon of speed of reversion is a particularly important and crucial component when designing a beta-based Black Swan strategy.

Keywords: Black Swan Investing, CAPM Beta, Excess Returns, Geopolitical Risk, Mean Reversion.

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1. Introduction

Geopolitical risk is commonly described as one of the determinants of investment decisions by central bankers, the financial press, and corporate executives (Caldara and Iacoviello, 2018). Caldara and Iacoviello (2018) found that geopolitical risk depresses business cycles, lowers stock returns, and leads to flows of capital from emerging economies towards advanced economies.

Recent years, geopolitical risk has dominated the news feed for the financial markets, especially after the imposition of trade and travel restrictions in 2020 as a result of the corona pandemic and Russia's invasion of Ukraine in the beginning of 2022. Empirical research has most focused on stock market behavior and economic policy uncertainty in order to explain equity market behavior which means that there are limited studies in the field of geopolitical risk.

An increase in the geopolitical risk resulting from a rise in uncertainty owing to military tensions, political regime changes, terrorist threats, corruption, and other factors, has been shown to disrupt economic activity and household income (Chan, Saffar & Wei, 2019). Furthermore, they found that geopolitical uncertainty could affect investors to take a more prudent attitude towards investments. Fear, pessimism, and other unpleasant sentiments induce investors to react intensely to political events, causing them to postpone their decision-making (Hillen et al., 2017). However, previous literature show that the financial markets are affected negatively by geopolitical risks at both the aggregate and sector level (see e.g., Chen and Siems, 2004; Charles and Darné, 2006).

There have historically been some geopolitical events that have resulted in major declines in the stock market and such a market day can be classified as a Black Swan. If an event has the following characteristics, it is called a Black Swan: A Black Swan is an outlier in econometrics and statistics, and nothing in the past can forecast its occurrence. It also has a significant impact, and humans try to explain and forecast it after it occurs (Taleb, 2010). In light of Black Swan events, a few days of extreme declines have substantial impact on long-term performance. An investment of $10,000 in the S&P 500 from January 3, 2000, to December 31, 2019, returns $22,421, however if the twenty worst days were removed, the investment returns $102,925 instead (J.P. Morgan Asset Management, 2020).

The CAPM beta is a frequently used measure of stock return sensitivity to market fluctuations. According to previous literature, beta is a good risk metric, at least in terms of appropriately representing the exposure to significant and unexpected market falls such as Black Swans that portfolio managers and investors are concerned about (see e.g., Chan and Lakonishok, 1993; Grundy and Malkiel, 1996; Estrada and Vargas, 2012). Estrada and Vargas (2012) also found evidence for beta as a tool for portfolio selection. They found that an investment strategy that invests in a high-beta portfolio when hitting a negative Black Swan and in a low-beta portfolio when hitting a positive Black Swan outperforms a benchmark portfolio over time.

Previous literature is missing whether the beta value is a good risk measure for large and unexpected market declines due to geopolitical events which gives the opportunity to fill a knowledge gap. Furthermore, previous literature is also missing whether it is possible to construct a beta-based portfolio strategy that takes advantage of negative geopolitical Black Swans. However, the purpose of this study is to investigate the area of CAPM beta and geopolitical risk where the main investigation is if beta is a useful tool for portfolio selection by taking advantage of negative geopolitical Black Swans.

In particular, this research investigates whether high-beta portfolios decline more than low-beta portfolios when the market falls significantly due to a geopolitical event and vice versa, as theory predicts for all Black Swan events. Furthermore, this study investigates if it is possible to outperform an index through an investment strategy that only considers CAPM beta where the geopolitical events classified as negative Black Swans are the starting point. This essay also investigates whether the beta-based investment strategy using on the negative geopolitical Black Swan is compared to a similar beta-based investment strategy, but which is instead applied to all Black Swans.

Estrada and Vargas (2012) explain the success of the beta-based portfolio strategy with mean reversion. Fama and French (1988) found large negative autocorrelations for return horizons longer than a year and shows that predictable price fluctuation owing mean reversion accounts for a large part of three-to-five-year return variances. For portfolios of small companies, predictable fluctuation is estimated to account for around 40% for the three-to-five-year of return variance, and 25% for large companies. By using the concept of mean reversion this study is investigating whether it is possible to construct a successful beta-based portfolio strategy applied mainly on negative geopolitical Black Swan events.

The idea with the investment strategy is to take advantage of the geopolitical events classified as a negative Black Swan rather than building a portfolio based on the non-occurrence of the Black Swan events, as is normally the case (Taleb, 2010). However, this paper combines the concept of mean reversion, the CAPM beta and negative geopolitical Black Swan events in order to create a strategy that might outperform an index. The strategy is formed as every time a negative geopolitical Black Swan happens, the following day the portfolio invests in high-beta stocks to take advantage of the stock market´s upward trend owing to mean reversion (Estrada and Vargas, 2012). This allocation is held until a general positive Black Swan event occurs where the portfolio is reallocated to a low-beta portfolio waiting for the next negative geopolitical Black Swan to repeat the process. By doing this process we also test if mean reversion is stronger after negative geopolitical Black Swan events than a general Black Swan event.

To analyze the robustness of how a Black Swan is defined and as there is no consistent definition of a Black Swan event for daily returns, this study chooses three different levels of definitions of a Black Swan. Namely, 3%, 4% or 5% when investigating if beta value is a good risk measure for large and unexpected market declines due to geopolitical events. This study only uses a definition of a Black Swan at 3% for the beta-based portfolio selection part and the reason is that a higher definition of a negative geopolitical event such as 4% is missing negative geopolitical Black Swan events between 03-24-03 and 06-24-16. For negative geopolitical Black Swans there should be no doubt that the geopolitical event has caused the downturn in the stock market.

Caldara and Iacoviello (2018) found that exogenous shifts in geopolitical risks reduce economic output and stock market returns in advanced economies. As this survey is something completely new in the field of geopolitical risk it may be optimal to start studying the stock market in United States because it is the world's largest capital market. On the other hand, several US stock market index do not include enough negative geopolitical Black Swans, instead, several advanced economies in the eurozone are investigated. It seems to be relevant to study the countries in the eurozone because many geopolitical events are related to large declines in the stock markets. Additionally, the countries' total market capitalization of listed domestic companies accounts for the second largest share of the developed countries in the world after the United States (The World Bank) (n.d.). EURO STOXX 50 index is chosen as the survey index because it is a popular index in order to follow the fluctuations in the eurozone. The EURO STOXX 50 index is a market capitalization-weighted index that covers

the fifty largest stocks in terms of market cap in the eurozone. Furthermore, according to the previous literature, there is a widely held view that emerging markets are more vulnerable to global and geopolitical shocks than developed economies, especially before the findings from Balcilar et al., 2018, Bouri et al., 2019, Caldara and Iacoviello (2018) and Salisu, Lasisi, and Tchankamm (2021) began to question it. Therefore, research have focused on emerging markets rather than developed, which also is an argument to choose developed markets as the investigation area.

The sample period for this study is between January 3, 2000, and March 31, 2022, in order to cover as many geopolitical events as possible without jeopardizing that there should be no doubt that the geopolitical event has caused the downturn in the stock market. More specifically, it is difficult to find quality newspapers before the 2000s and thus the 2000s are chosen as the survey period.

2. Literature Review and Theoretical Framework

2.1 Geopolitical Risk

Caldara and Iacoviello (2018) found that geopolitical risk depresses business cycles, lowers stock returns, and leads to flows of capital from emerging economies towards advanced economies. A change in the geopolitical risk resulting from a rise in uncertainty owing to military tensions, political regime changes, terrorist threats, corruption, and other factors, has been shown to disrupt economic activity and household incomes (Chan, Saffar & Wei, 2019). Further, geopolitical uncertainty could affect investors to take a more prudent attitude towards investments (Hillen et al., 2017).

Caldara and Iacoviello's (2018) study on geopolitical risk has been one of the most exciting studies in recent years in the field of geopolitical risk. They create a geopolitical risk index that reflects an important dimension of uncertainty as well as the possibility of unexpected events disrupting the normal, democratic, and peaceful course of relations between governments, citizens, and territories. As an indicator of geopolitical risk, the index is widely used. They also found that exogenous shifts in geopolitical risks reduce economic output and stock market returns in advanced economies, particularly in the United States. Their findings suggest that increasing geopolitical risk causes a short-term but considerable decline in market returns. Furthermore, they found that stock market response varies significantly among industries, with positive excess returns in the defense industry and negative returns in sectors linked to the broader economy, such as steelworks and mining.

According to Salisu, Lasisi, and Tchankamm (2021), geopolitical risk is a key predictor of stock returns in most advanced economies, and these countries' stock markets are exposed to geopolitical risk. They argue that those findings imply that larger geopolitical risks cause stock market declines and is in line with their hypothesis. They also find that geopolitical threats (such as threats of war and terrorism) have a bigger impact on stock prices than their actual occurrence, which was expected, because the impact of news on macroeconomic variables is well-established in economic theory.

By observing the economic and financial effects, as well as geopolitical risk, investors are able to outperform the market and generating excess returns from trading in the US stock market (Rehman, et al., 2022). On the other hand, for several emerging markets, studies have

shown that geopolitical risk affects stock market volatility rather than stock market returns (see e.g., Balcilar et al., 2018; Bouri et al., 2019).

Within the literature of geopolitical risk, there is well documented and expanding studies on the impact of terrorist attacks on financial markets. According to Lenain, Bonturi, and Koen (2002), after 9/11, the New York Stock Exchange (NYSE) paused all trading until September 17th, and the Dow Jones Industrial Average fell 14% in the week that followed. Similarly, Karolyi and Martell (2010) concluded a 0.83 percent negative stock price reaction per firm per attack.

Aslam and Kang (2015) study emerging stock markets and conclude that terrorist attacks have a short-term negative impact on Pakistan stock returns, claiming that the magnitude of the effect varies depending on the location and type of attack. Balcilar, Cerci, and Demirer (2016) investigate how terrorist attacks affect stock market returns and volatility in G7 countries. They found that terror attacks have considerable effects on returns in the majority of cases for some higher and lower quantiles, but only in the cases of Japan and the United Kingdom for some moderate upper quantiles.

2.2 Definition of a Geopolitical Black Swan Event

The empirical literature within behavioral finance have documented explanations for investor sentiment and investors' desire to hedge against economic uncertainties, resulting in stock market returns that underreact or overreact to positive or bad news (see e.g., Barberis, Shleifer, and Vishny 1998; Daniel, Hirshleifer, and Subrahmanyam, 1998; Veronesi, 1999). The publication of Taleb's (2010) book, "The Black Swan: The Impact of the Highly Improbable", has renewed interest in these substantial and unexpected movements in asset values. However, in this paper large, unexpected fluctuations in stock market is referred as a Black Swan event.

The first stage in our investigation is to identify the appropriate Black Swans. A Black Swan, according to Taleb (2010), is an event that has three characteristics: 1) in a statistically perspective, it is an outlier, because nothing in the past can certainly point to it occurring outside the range of normal expectations; 2) it has a large impact; and 3) despite the fact that it is an outlier, reasonable explanations can be developed after the fact, creates the appearance that it is explainable and predictable. Rarity, significant effect, and retroactive predictability are three features that define a Black Swan.

In the literature, there is no consistent quantitatively definition of how to evaluate when a Black Swan occurs. Estrada and Vargas (2012) define a Black Swan as an increase or decrease in return of at least 5% on a monthly basis. On the other hand, Chatzikonstanti and Karoglou (2020) define a Black Swan more generally, if the standardized unexpected return value of an observation exceeds a threshold value, such as three standard deviations above or below the mean. In this thesis, a reasonable explanation of the defined Black Swan event is a geopolitical event and therefore a geopolitical Black Swan is defined as a decrease in return on daily basis. However, this study chooses three different levels of definitions of a Black Swan, 3%, 4% or 5%, when investigating if beta value is a good risk measure for large and unexpected market declines due to geopolitical events. This study only uses a definition of a Black Swan at 3% for the beta-based portfolio selection part and the reason is that a higher definition of a negative geopolitical event such as 4% is missing negative geopolitical Black Swan events between 03-24-03 and 06-24-16. The definitions used were designed to find the right balance between a decline being significant enough to be called a Black Swan and low enough to obtain enough data to make this study useful.

By combining the literatures on Black Swan and geopolitical risk, it is possible to explain the occurrence of Black Swans with different types of events, such as financial events, political events, military or terrorist events and trade and travel restrictions. The literature on geopolitical risk does not fully agree on which of them should be classified as a geopolitical event, especially for political events. For example, Caldara and Iacoviello (2018) argue that political events should be excluded due to its domestic character while Engle and Campos-Martins (2020) only measure geopolitical risk based on the financial market prices which also incorporate political events. In this study, military and terrorist events, political events and travel and trade restrictions is included. The inclusion of political events is motivated by the choice to examine the stock market in the eurozone area. Specifically, any event that is believed to affect the eurozone economy and its investors also probably affects the world economy and the entire capital market because the eurozone area is a significant share of the world economy and the world capital market.

Ideally the Black Swan event should be a pure effect of a geopolitical event; there should be no doubt that the geopolitical event has caused the downturn in the stock market. The procedure starts by reading American and European financial newspapers in connection to the defined Black Swan events in order to discover whether a potential geopolitical event have affected the stock market return this day. After this step 42 market days fulfill the requirement

for a negative geopolitical event. Further, the measure of geopolitical risk constructed by Caldara and Iacoviello (2018) is used to ensure that the event increase the geopolitical risk in the majority of the countries included in eurozone. If the geopolitical risk has increased significantly after the geopolitical event, we conclude that the effect is pure. This is possible because the literature in the area of geopolitical risk shows that an increase in the index affects the stock market, both in terms of volatility and returns for developed markets such as the countries in the Eurozone. After this step 39 market days fulfill the requirement for a negative geopolitical event. Three market days have therefore been excluded. This is illustrated in Table 1 where the three excluded market days are marked in red and strikethrough.

Table 1 shows all negative geopolitical Black Swan events defined at 3% with associated dates, returns and event explanation. Those market days that have been described as being at least partly caused by geopolitical risk but have not contributed to an increase in the index for geopolitical risk constructed by Caldara and Iacoviello (2018) are marked in red and strikethrough.

Date	Change %	Event explanation
09-11-01	-6,41	11-sep
09-14-01	-6,15	11-sep
09-20-01	-4,42	11-sep
09-23-02	-3,92	Iraq concerns
01-17-03	-3,42	Iraq concerns
01-27-03	-3,58	Iraq concerns
02-19-03	-3,18	Iraq concerns
02-25-03	-3,67	Iraq concerns
03-12-03	-4,38	Iraq War
03-24-03	-5,53	Iraq War
03-11-04	-3,03	Madrid train bombings
~~**11-06-08**~~	~~-6,22~~	~~US election~~
06-15-09	-3,10	Iranian election
03-06-12	-3,41	Political tension Iran/Israel
02-26-13	-3,07	Italian election
03-03-14	-3,02	Russian/Ukraine Concerns
~~**10-15-14**~~	~~-3,61~~	~~Rising Ebola Fears~~
~~**01-20-16**~~	~~-3,28~~	~~Lifting sanctions on Iran~~
06-24-16	-8,62	Brexit
12-06-18	-3,31	U.S.-China trade war

08-02-19	-3,26	U.S.-China trade war
02-24-20	-4,01	Covid
02-28-20	-3,66	Covid
03-06-20	-3,91	Covid
03-09-20	-8,45	Covid/Collapse of OPEC talk
03-12-20	-12,40	Covid/US ban travelers from Europe
03-16-20	-5,25	Covid
03-18-20	-5,72	Covid
03-27-20	-4,18	Covid
04-01-20	-3,83	Covid
04-21-20	-4,06	Covid/oil falling
05-04-20	-3,81	US threat to impose more tariffs on China
06-11-20	-4,53	Covid
06-24-20	-3,11	Covid
09-21-20	-3,74	Covid
10-28-20	-3,49	Covid
11-26-21	-4,74	Covid
01-24-22	-4,14	Fear of Russian/Ukraine War
02-24-22	-3,63	Russian/Ukraine War
03-01-22	-4,04	Russian/Ukraine War
03-04-22	-4,96	Russian/Ukraine War
03-10-22	-3,04	Russian/Ukraine War

2.3 Mean Reversion

Stock price and stock returns fluctuations are sometimes classified into two categories. The random walk hypothesis is based on the idea that prices cannot be predicted by past information and hence follows a random walk. This concept is in line with the efficient market hypothesis, which states that asset prices fully and instantaneously reflect information, making prices unpredictably volatile (Hiremath & Kamaiah, 2010). The idea basically claims that stock prices are generated by random walks, which can be compared to flipping a coin with fully random results. In order to generate the trends, Geometric Brownian motion is used which is a continuous time stochastic process, as a result, both short and long-term stock price fluctuations are impossible to anticipate using historical information (Fama, 1965).

The other perspective asserts that future stock market return movements can be estimated using historical data because stock returns tend to return to their trend path, a concept known as mean-reversion, with the degree of mean-reversion believed and proven to increase as the investment horizon lengthens (Siegel, 2008). According to Siegel (2008), in a long-run perspective for the stock market behavior, mean-reversion has been empirically proved to dominate the random walk hypothesis. Thus, stock market returns tend to move in the direction of its long-term average in the long run (Metcalf & Hasset, 1995).

Several studies have demonstrated the existence of mean-reversion in various stock markets in various nations and across various time periods. Fama and French (1988) found large negative autocorrelations for return horizons longer than a year on New York Stock Exchange between 1926-1985. Further, they show that predictable price fluctuation owing mean reversion accounts for a large part of three-to-five-year return variances. For portfolios of small companies, predictable fluctuation is estimated to account for around 40% for the three-to-five-year of return variance, and 25% for large companies.

Within the theory of mean reversion, there is a relevant component that is important in this study, namely the concept of speed of reversion. Speed of reversion refers to the speed at which a variable return to long-term average (Metcalf & Hasset, 1995). Balvers, Wu and Gilliland (2000) argue that relative mean reversion is more important than absolute mean reversion and show that the stationary relationship between a stock's fundamental value and a market index allows for direct measurement of mean reversion speed. Further, several studies shows that the speed of reversion changes over time (see e.g., Poterba and Summers,1988; Spierdijk, Bikker and Van Den Hoek, 2012).

This paper is not attempting to show specifically the existence of mean-reversion on the EURO STOXX 50 index, but instead the essay refers to studies such as Fama and French (1988), Hiremath & Kamaiah (2010), MacKinlay and Ramaswamy (1988), Metcalf & Hasset (1995), and Miller, Muthuswamy and Whaley (1994). However, all the above studies show significant negative autocorrelation and hence mean reversion behavior on different stock markets. Further, this essay tests for mean reversion behavior through the beta-based portfolio strategy. If the strategy outperforms the EURO STOXX 50 index, it is possible to conclude that EURO STOXX 50 index have a mean-reverting behavior.

2.4 Beta and the Capital Asset Pricing Model

In several decades, the Capital Asset Pricing Model (CAPM) has been one of the most commonly used, implemented, and discussed asset pricing models. According to CAPM, the asset's expected return is determined by its exposure to the systematic risk factor. As a result, the only option for an investor to get a better return is to take on more risk. The asset's beta captures the risk level, with a higher beta indicating a larger return at the cost of increased risk. The beta is measured by the following equation:

$$\beta_i = \frac{cov(R_i, R_m)}{var(R_m)}$$

Where, β_i is the beta of asset i, $cov(R_i, R_m)$ refers to the covariance between the returns for asset i and the market returns and $var(R_m)$ is the variance of the market returns.

Pettengill, Sundaram and Mathur (1995) shows that there is a significant relationship between CAPM beta and cross-sectional returns. They showed that there is a positive relation between beta and returns when the market is in an upward phase and negative when the market is in a downward phase. Taking this into account, this paper use beta in the investment strategy to evaluate if it is a good measure of geopolitical risk and as an appropriate tool for constructing portfolios that are subject to market movements.

3. Methodology and Data

3.1 Methodology

This essay examines the impact of negative geopolitical Black Swans on portfolios of stocks in EURO STOXX 50 index grouped by beta in order to determine whether beta is a good measure of geopolitical risk. In particular, this research investigates whether high-beta portfolios decline more than low-beta portfolios when the market falls significantly due to a geopolitical event and vice versa, as theory predicts for all Black Swan events. Furthermore, this study investigates if it is possible to outperform an index through an investment strategy that only considers CAPM beta where the geopolitical events classified as negative Black Swans are the starting point. This essay also investigates whether the beta-based investment strategy using on the negative geopolitical Black Swan is compared to a similar beta-based investment strategy, but which is instead applied to all Black Swans.

The steps are as follows: 1. When a negative geopolitical Black Swan event occurs in the market, the betas for each stock in our sample are estimated using data from the five years prior to, but not including the geopolitical Black Swan market day. The choice of five years estimation period is in line with the estimation period used by Estrada and Vargas (2012). Then, based on those betas, all stocks are sorted and divided into two portfolios, one containing the ten stocks with highest and the other containing ten stocks with lowest. The return is then determined as an equally-weighted average of the returns of the stocks in both portfolios for the geopolitical Black Swan event. For each negative geopolitical Black Swan, this provides one return for the two portfolios, and the average is then determined for the returns of each portfolio across all negative geopolitical Black Swans between January 3, 2000, and March 31, 2022. Thus, the average decline is determined for the high-beta (high systematic risk) respectively for the low-beta portfolio (low systematic risk). After completing this initial stage of the essay, it is possible to determine whether beta is a good indicator of geopolitical risk during volatile market days.

2. The issue of whether beta is a useful tool for portfolio selection is examined. Further, a beta-based investment strategy is developed that takes into consideration the well-known pattern of mean reversion. More specifically, the strategy accounts for the tendency of stock markets to revert to their long-term mean, as presented in the previous section. The hypothesis is that markets will likely rise after negative geopolitical Black Swans respectively decline after the following positive Black Swans in the presence of mean reversion. Thus, after

a negative geopolitical Black Swan, the high-beta portfolio is likely to increase more than the low-beta portfolio, and after the following positive Black Swan the low-beta portfolio are likely to decrease less than the high-beta portfolio.

As a result of this reasoning, the following investment strategy is devised: Invest in a high-beta portfolio the day after the negative geopolitical Black Swan occurs and thus allocate to stocks that are expected to increase the most. Further, invest in a low-beta portfolio the day after the following positive Black Swan event and thus allocate to stocks that are expected to decline the least. Then, we are waiting for the next negative geopolitical Black Swan to repeat the process.

To implement this approach, betas for all stocks are estimated five years prior to the geopolitical Black Swans. All stocks are then sorted according to their betas, divided into a high-beta and low-beta portfolio, and invested in the high-beta or low-beta portfolio. The EURO STOXX 50 index is also used as a benchmark through a passive investment strategy (buy-and-hold) in order to investigate whether the active beta-based strategy outperform the benchmark.

If there are two separate negative geopolitical Black Swans in a row without any positive Black Swan event in between, the two portfolios are still being rebalanced. This is due to the fact that beta vary over time and the high and low-beta portfolios also may vary between negative geopolitical Black Swans. In fact, after each negative geopolitical Black Swan, the rebalancing ensures that the strategy is allocated to the riskiest or least risky stocks in the EURO STOXX 50 index. After completing the second stage of the essay, it is possible to determine whether beta is a valuable tool for portfolio selection which is based on geopolitical events.

3. The beta-based investment strategy based on the negative geopolitical Black Swans is compared to a similar beta-based investment strategy, in which all Black Swans are used. In the geopolitical Black Swan strategy financial events leading to large declines in the stock market are excluded, likewise all positive Black Swans except the first one after a negative geopolitical Black Swan are excluded. Estrada and Vargas (2012) used a beta-based investment strategy for all positive and negative Black Swans, without considering about what type of event caused it. However, by comparing the geopolitical Black Swan strategy with the general Black Swan strategy allows us to discuss the issue. Specifically, whether a negative

geopolitical Black Swan event and their following positive Black Swan is a better point to reallocate the portfolio than at any Black Swan event in order to take more advantage of the stock market's mean-reverting behavior.

3.2 Data and Delimitation

The last decade, geopolitical risk has been more popular to study, and previous research have mostly focused on emerging markets because there have been a widely held view that emerging markets are more vulnerable to global and geopolitical shocks than developed economies. This was something that Caldara and Iacoviello (2018) questioned because they found that exogenous shifts in geopolitical risks reduce economic output and stock market returns in advanced economies. However, as this study is something completely new in the field of geopolitical risks it may be optimal to start studying the stock market in United States because it is the world's largest capital market. On the other hand, several US stock market index does not include enough negative geopolitical Black Swan events, instead, several advanced economies in the eurozone are investigated. It seems to be relevant to study the countries in the eurozone because many geopolitical events are related to large declines in the stock markets. Additionally, the countries' total market capitalization of listed domestic companies accounts for the second largest share of the developed countries in the world after the United States (The World Bank) (n.d.). EURO STOXX 50 index is chosen as the survey index because it is a popular index in order to follow the fluctuations in the eurozone. The EURO STOXX 50 index is a market capitalization-weighted index that covers the top 50 stocks in the eurozone.

The sample period for this study is between January 3, 2000, and March 31, 2022, in order to cover as many geopolitical events as possible without jeopardizing that there should be no doubt that the geopolitical event has caused the downturn in the stock market. More specifically, it is difficult to find quality newspapers before the 2000s and thus the 2000s are chosen as the survey period.

In this time period and with a definition of a Black Swan at 3%, a total of 39 negative geopolitical Black Swan events have been found and are shown in Table 1. Further, a high-beta and a low-beta portfolio is constructed, consisting of ten stocks with the highest/lowest beta on EURO STOXX 50 index. This data was found through combining the databases Bloomberg and FactSet. All the historical companies based on estimated historical betas needed to construct the beta portfolios and all returns for those companies that have been

delisted before March 31, 2022, were founded in Bloomberg. The returns for those companies that are still listed and returns from EURO STOXX 50 index are taken from FactSet.

There are a total of 69 companies included in the whole study and those companies have either been among the 10 companies with the highest/lowest beta or both. It is measured during a five-year period before each included market day where reallocation takes place of the constructed portfolio. Further for the beta-based geopolitical investment strategy reallocation takes place 62 times, including both negative geopolitical Black Swans and the following positive Black Swans.

4. Results

4.1 Beta as a Measure of Geopolitical Risk

We start by investigating the question whether the beta value is a good risk measure for large and unexpected market declines due to geopolitical events in the future. This study investigates the daily movements in the constructed high and low beta-based portfolios where the hypothesis is that the high-beta portfolio should decrease more than EURO STOXX 50 index respectively less for the low-beta portfolio. The beta values are calculated for all stocks listed on the EURO STOXX 50 index. By excluding the day of the Black Swan and based on a five-year estimation period, the ten stocks with the highest beta value are assembled into a high-beta portfolio, while the ten stocks with the lowest beta value are assembled into a low-beta portfolio. All other stocks with beta values in the middle of the high and low-beta portfolio will not be invested in.

Table 2 below compares how three different portfolios, which consisting of the EURO STOXX 50 index, high-beta stocks, and low-beta stocks, respond on average to a negative geopolitical Black Swan. The negative geopolitical Black Swan is defined as a decline of at least three percent, at least four percent respectively at least five percent on a single market day on the EURO STOXX 50 index.

Table 2 shows the average beta and return at a 3%, 4% and 5% geopolitical Black Swan definition for a low-beta portfolio, the EURO STOXX 50 index, and a high-beta portfolio.

Defined at 3%	***Low-Beta Portfolio***	***EURO STOXX 50 Index***	***High-Beta Portfolio***
Average Beta	0,77	1,00	1,27
Average Return	-3,24 %	-4,46 %	-6,09 %
Paired t-test	8,9***		-6,29***
Standard Error	0,14		0,26
Defined at 4%	***Low-Beta Portfolio***	***EURO STOXX 50 Index***	***High-Beta Portfolio***
Average Beta	0,77	1,00	1,26
Average Return	-3,70 %	-5,67 %	-7,57 %
Paired t-test	7,74***		-3,61***
Standard Error	0,25		0,53
Defined at 5%	***Low-Beta Portfolio***	***EURO STOXX 50 Index***	***High-Beta Portfolio***
Average Beta	0,78	1,00	1,25
Average Return	-4,88 %	-7,31 %	-10,18 %
Paired t-test	4,97***		-3,03***
Standard Error	0,49		0,95

Note: Statistical Significance levels are defined as follows: *** 1%, ** 5%, * 10%.

For the first definition of a negative geopolitical Black Swan in this study 39 market days fulfill the requirement. The average return is calculated for the three portfolios and shows that the return of the high-beta portfolio decreases more on average compared to the EURO STOXX 50 index and the low-beta portfolio decrease less than the index. When a negative geopolitical Black Swan appears the return of the high-beta portfolio decreases with 6,09% on average and the low-beta portfolio decreases with 3,24% on average. Further, the high-beta portfolio decreases with 1,63 percentage points more than the EURO STOXX 50 index, while the low-beta portfolio decreases with 1,12 percentage points less than index. A paired t-test have been calculated for both the high and low-beta portfolios and shows significant results at 1% level.

For the second definition of a negative geopolitical Black Swan in this study, 18 market days fulfill the requirement. The average return is calculated for the three portfolios and shows that the return of the high-beta portfolio decreases more on average compared to the EURO STOXX 50 index and the low-beta portfolio decrease less than the index. When a negative geopolitical Black Swan appears the return of the high-beta portfolio decreases with 7,57% on average and the low-beta portfolio decreases with 3,70% on average. Further, the high-beta portfolio decreases with 1,90 percentage points more than the EURO STOXX 50 index, while the low-beta portfolio decreases with 1,97 percentage points less than index. A paired t-test have been calculated for both the high and low-beta portfolios and shows significant results at 1% level.

For the third definition of a negative geopolitical Black Swan in this study 8 market days fulfill the requirement. The average return is calculated for the three portfolios and shows that the return of the high-beta portfolio decreases more on average compared to the EURO STOXX 50 index and the low-beta portfolio decrease less than the index. When a negative geopolitical Black Swan appears the return of the high-beta portfolio decreases with 10,18% on average and the low-beta portfolio decreases with 4,88% on average. Further, the high-beta portfolio decreases with 2,87 percentage points more than the EURO STOXX 50 index, while the low-beta portfolio decreases with 2,43 percentage points less than index. A paired t-test have been calculated for both the high and low-beta portfolios and shows significant results at 1% level.

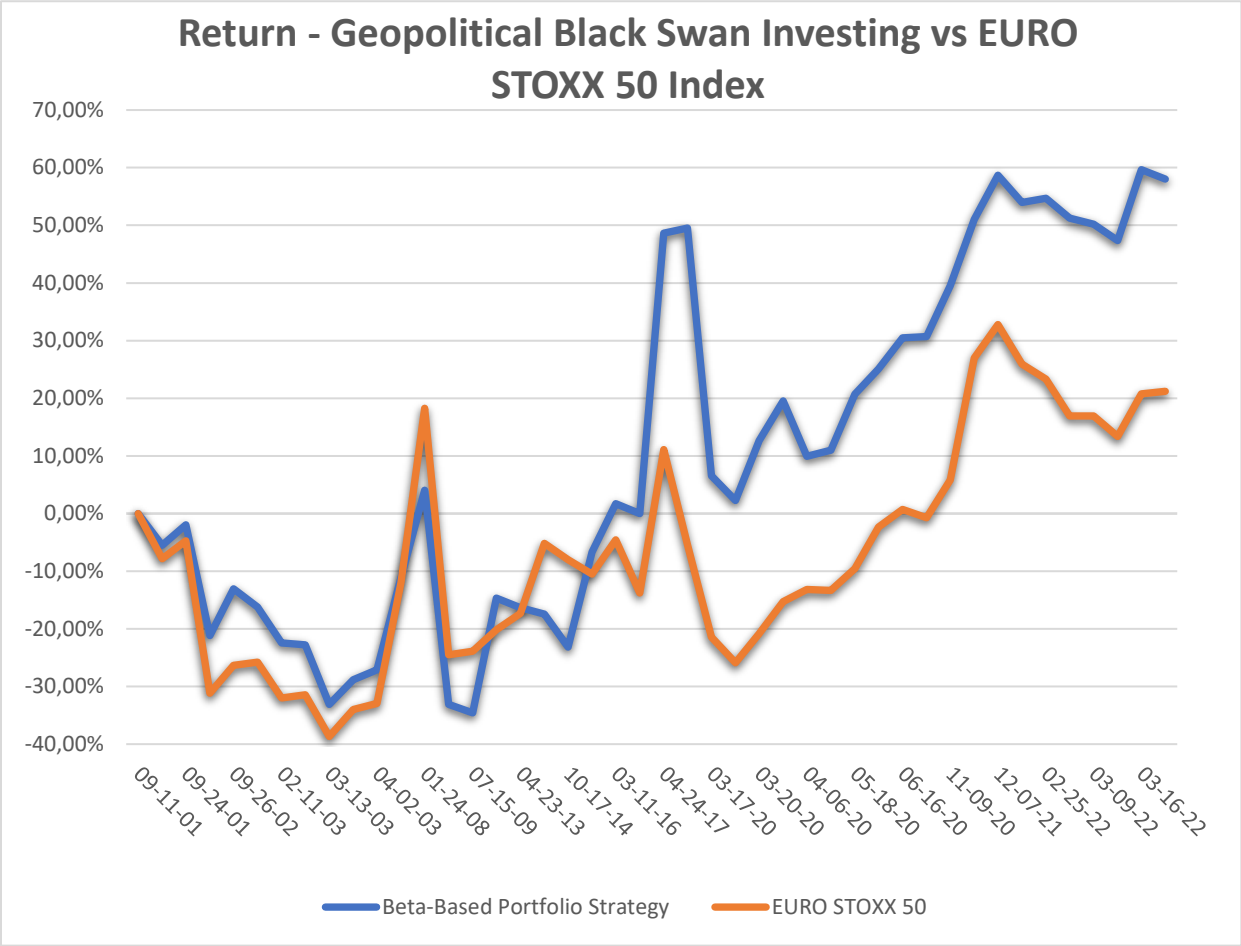
4.2 Beta-Based Portfolio Strategy

We now move on to the question whether CAPM beta is a useful tool for portfolio selection and hence outperforms an index, specifically the EURO STOXX 50 index in this study. If the beta-based portfolio outperforms the benchmark, it can be concluded that beta is a beneficial tool for portfolio selection for equities listed on the EURO STOXX 50 index. Further, this essay tests for mean reversion behavior through the beta-based portfolio strategy. If the strategy outperforms the EURO STOXX 50 index, we conclude that EURO STOXX 50 index have a mean-reverting behavior.

Given that a negative geopolitical Black Swan is defined as a decline of at least three percent on a single market day on the EURO STOXX 50 index, the first date of a negative geopolitical Black Swan event in the 21st century is September 11, 2001, and this market day yields a return of -6,41%. This date is also the day before when the first investment is made in both the beta-based and the index portfolio. The first investment in the beta-based portfolio was made in the 10 stocks with the highest beta value, based on underlying argument for our investment approach. In order to generate abnormal returns when the market ascends and reverts to its long-term mean, as predicted by mean reversion theory. A second negative geopolitical Black Swan occurs on September 14, 2001, and the daily return is -6,15% on the EURO STOXX 50 index and the portfolio is rebalanced. The next important market day is September 17, 2001, which is a general positive Black Swan, and the index yields 3,68 %. The next day, the high-beta portfolio is sold and replaced with a low-beta portfolio to hedge against the market's falling trend as it is expected to revert to its long-term mean, as predicted by the theory. The same approach for the beta-based portfolio strategy is applied for all negative geopolitical events and the following positive Black Swan market day until March 31, 2022.

Figure 1 depicts the value movements of the beta-based and the index portfolios across the research period, with the Black Swan defined as a decline of at least three percent on a single market day on the EURO STOXX 50 index. On the same end-date, the beta-based portfolio had returned 58,05%. The beta-based portfolio strategy outperformed the EURO STOXX 50 Index with a 36.86 percentage point excess return throughout the investing period.

Figure 1 shows the evaluation of the total return for the geopolitical beta-based portfolio and the EURO STOXX 50 Index between September 11, 2001, and March 31, 2022, where the x-axis shows the date of every other geopolitical event, regardless of how long it is between.



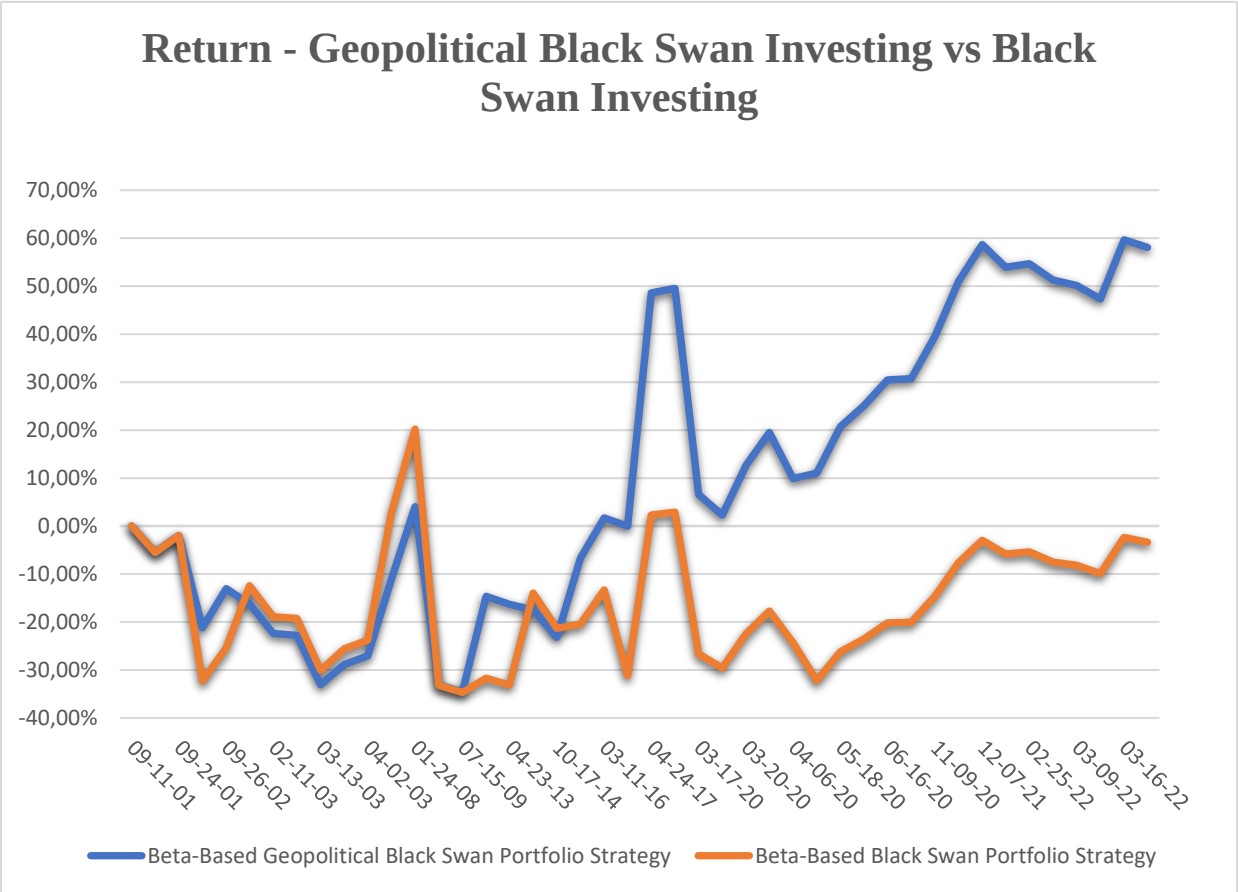
4.3 Geopolitical Black Swan Investing vs Black Swan Investing

We now ask the question whether a geopolitical Black Swan investment strategy is a better tool for portfolio selection than a general Black Swan investment strategy. If the geopolitical Black Swan investment strategy works best, we conclude that geopolitical Black Swan events are useful for portfolio selection for equities listed on the EURO STOXX 50 index. The general Black Swan strategy includes 257 market days where reallocation takes place while the geopolitical Black Swan strategy includes 62 market days where reallocation takes place, including the first and the last one for both strategies. Further, this essay tests for mean reversion behavior through the different strategies where the length between the defined Black Swan events differs. Specifically, the length of the geopolitical Black Swan strategy is longer than for the general Black Swan approach.

Figure 2 depicts the value movements of the different Black Swan portfolios across the research period, with the Black Swan defined as a decline of at least three percent on a single

market day on the EURO STOXX 50 index. On September 11, 2001, the first Black Swan appeared for both strategies. The general beta-based Black Swan portfolio had returned -3,35% as of the end-date of March 31, 2022. On the same end-date, the beta-based geopolitical Black Swan portfolio had returned 58,05%. The beta-based geopolitical Black Swan portfolio outperformed the general beta-based Black Swan portfolio with a 61,40% percentage point excess return throughout the investing period.

Figure 2 shows the evaluation of the total return for the beta-based geopolitical Black Swan portfolio and the beta-based Black Swan portfolio between September 11, 2001, and March 31, 2022, where the x-axis shows the date of every other geopolitical event, regardless of how long it is between.



5. Discussion

5.1 Beta as a Measure of Geopolitical Risk

For decades, there has been a discussion about the use of beta as a measure of systematic risk and the CAPM as an adequate model for estimating expected returns. No single paper has investigated whether beta is a good measure of geopolitical risk. The first part of the study should answer the question whether the beta value is a good risk measure for large and unexpected market declines due to geopolitical events in the future. According to Chan and Lakonishok (1993), comprehensive conservations with money managers suggest that their greatest fair is downside risk. Furthermore, Grundy and Malkiel (1996) found that investors define risk as the probability of losing money in a falling market.

As noted in the past chapter, this research found a statistically significant relationship between the CAPM beta value and a portfolio's negative return on market days characterized by increased geopolitical risk and uncertainty. Further, there is a negative correlation between the CAPM beta value and the return for the average negative geopolitical Black Swan. The relationship remains true and statistically significant for all of the study's definitions of a negative geopolitical Black Swan. This indicates that high-beta stocks are more sensitive to geopolitical risk than low-beta stocks, and that a negative geopolitical Black Swan event will result in greater declines for those stocks. In contrary, low-beta stocks are less sensitive to geopolitical risk than high-beta stocks, and that a negative geopolitical Black Swan event will result in minor declines for those stocks. Thus, the findings imply that the theory behind the CAPM holds true for geopolitical risk, and so can be incorporated in the idea of systematic risk.

The most comparable study is that of Estrada and Vargas (2012), they show evidence for beta as a measure of downside risk that spans over 47 countries, 57 industries and a 40-year time-period. Their result point in the same direction as this thesis with the big difference that this study only examines unexpected market declines due to geopolitical events. On the other hand, they only investigate from an economic point of view while this essay examines it from a statistical point of view where all the results are statistically significant at 1%.

It should be emphasized that the results generated are based on the ten stocks with the highest and lowest beta on the EURO STOXX 50 index, with a five-year estimation period prior to all negative Black Swan events. It is both reasonable and likely that the beta value for individual stocks and/or assets in another market is not a valid indicator of geopolitical risk. However,

based on the findings of the study, it seems that beta is a good risk measure for geopolitical risk, at least for large and unexpected market declines due to geopolitical risk, which concerns both money managers and investors.

5.2 Beta-Based Portfolio Strategy

Is CAPM beta a useful tool for portfolio selection and hence outperforms the EURO STOXX 50 index? A portfolio strategy where the CAPM beta is used as the tool for investment decision together with defined negative geopolitical Black Swans is considered. The results have been compared to a portfolio which follows the EURO STOXX 50 index. The constructed portfolio has outperformed the market index, as shown in the figure 1 in the previous part of this study.

Given that the negative geopolitical Black Swan is defined as a decline of at least three percent on a single market day on the EURO STOXX 50 index, the constructed portfolio has outperformed the market index with an excess return of 36,86%. Over the nearly 21-year timeframe from the first investment 09-12-01 to the end-date 03-31-22, the investment portfolio has generated a positive return of 58,05%. Over the same time period, the EURO STOXX 50 index has generated a positive return of 21,19%.

The investigated time-period is divided into 44 sub-periods where reallocation takes place in addition to the first and last geopolitical event. In 28 of 44 sub-periods the portfolio strategy works well where the portfolio invests in high-beta stocks when the market index goes up and the portfolio invests in low-beta stocks when the market index declines. It is noteworthy that the portfolio applies the wrong strategy seven of the first twelve sub-periods, which indicates that the strategy should only be considered in the long-term.

As mentioned before, the most comparable study is that of Estrada and Vargas (2012), they show evidence for beta as a tool for portfolio selection. Their result point in the same direction as this thesis with the big difference that this study's portfolio selection part is only based on negative geopolitical Black Swans and their following positive Black Swan instead of all Black Swans. Hence, their portfolio outperforms the world market index and found that beta appears to be a useful tool for portfolio selection which is in line with the results in this study.

The underlying idea of the constructed beta-based portfolio strategy is that it tries to take advantage of the theory of mean reversion. Further, the portfolio strategy outperforms the

benchmark which makes mean reversion a contributing explanation for the excess return, and it is reasonable to conclude that EURO STOXX 50 index have a mean-reverting behavior. On the other hand, this paper is not attempting to show specifically the existence of mean-reversion on the EURO STOXX 50 index, only that there is an indicating mean-reverting behavior.

Furthermore, there is two factors within the mean reversion theory that makes the discussion more complex. Firstly, the speed of reversion is unknown on the EURO STOXX 50 index which, this means that the five-year estimation window for beta values and the negative geopolitical Black Swan definitions are not guaranteed to be appropriate. It may be the case that the speed of reversion is faster than expected and makes it possible to gain a higher excess return by lowering the definition of the negative geopolitical Black Swan in order to take advantage of the faster speed of reversion. In contrary, if the speed of reversion is slower than expected, a higher definition of a negative geopolitical Black Swan could hypothetically take advantage of longer reverting periods and increase the portfolio return. But as earlier mentioned, the problem with a higher definition of a negative geopolitical event such as 4% is that negative geopolitical Black Swan events missing between 03-24-03 and 06-24-16. Secondly, in which extent the magnitude of a Black Swan affects the mean reversion behavior is also unknown. Specifically, there is not certain that the speed of reversion is affected symmetrically of all negative geopolitical Black Swans, it may differs depending on the how large the decline is, and this is something we have not considered in this study. However, the speed of reversion is further discussed in next section.

This study found that beta appears to be a useful tool for portfolio selection at least in terms of identifying portfolios that increase more than the market after a negative geopolitical Black Swan and decline less than the market after the following positive Black Swan. According to the results in this study, such a strategy is likely to outperform the EURO STOXX 50 index in the long-run.

5.3 Geopolitical Black Swan Investing vs Black Swan Investing

Is a geopolitical Black Swan investment strategy a better tool for portfolio selection than the general Black Swan investment strategy used of Estrada of Vargas (2012)? The chosen beta-based strategy applied to negative geopolitical Black Swan events have been compared to a similar portfolio strategy with the big difference that it is applied on all negative and positive Black Swans. The constructed beta-based negative geopolitical Black Swan strategy has

outperformed the general beta-based Black Swan strategy, as shown in figure 2 in the previous part of this study.

Given that the negative geopolitical Black Swan is defined as a decline of at least three percent on a single market day on the EURO STOXX 50 index, the constructed portfolio has outperformed the comparable strategy with an excess return of 61,40%. Over the nearly 21-year timeframe from the first investment 09-12-01 to the end-date 03-31-22, the investment portfolio has generated a positive return of 58,05%. Over the same time period, the general beta-based Black Swan has generated a return of -3,35%.

As mentioned before, Estrada and Vargas (2012) found evidence for beta as a tool for portfolio selection, specifically through a general Black Swan strategy which result in excess return. In this respect, our studies show conflicting results, which probably depends on the definition of a Black Swan and thus the length between each Black Swan, given that the speed of reversion does not differ significantly between the EURO STOXX 50 index and the world market index used in Estrada and Vargas (2012).

The results of this study seem to show that the phenomenon of speed of reversion is a particularly important and crucial component when designing a beta-based Black Swan strategy. Further, for the geopolitical Black Swan strategy, the average days between the Black Swans where the type of strategy changes, from a high-beta portfolio to a low-beta portfolio and vice versa is 122 market days. For the general Black Swan strategy, there is 39 market days on average between the Black Swans where the type of strategy changes. However, the return for the two different strategies differs considerably and the coincidence cannot be ruled out, but it strongly points that it can be explained by speed of reversion. It seems to be the case that the speed of reversion on EURO STOXX 50 index is on average slower than 39 market days which makes the definition of 3% for all positive and negative Black Swans too low.

There is a possibility that the magnitude of a Black Swan affects the speed of reversion and there is not certain that the speed of reversion is affected symmetrically of all negative geopolitical Black Swans. Furthermore, it may differs depending on the how large the decline is or the type of event causing the Black Swan. It may be case that after a negative geopolitical Black Swan the speed of reversion is significantly different to an average Black Swan. However, this is not considered in this study but could also be crucial for future construction of a beta-based portfolio strategy.

6. Conclusion

The purpose of this essay was to investigate the area of CAPM beta and geopolitical risk where the main investigation is if beta is a useful tool for portfolio selection by taking advantage of negative geopolitical Black Swans. Additionally, previous literature is missing whether the beta value is a good risk measure for large and unexpected market declines due to geopolitical events.

In particular, this research investigates whether high-beta portfolios decline more than low-beta portfolios when the market falls significantly due to a geopolitical event, as theory predicts for all Black Swan events. Furthermore, this study investigates if it is possible to outperform an index through an investment strategy that only considers CAPM beta where the geopolitical events classified as negative Black Swans are the starting point. This essay also investigates whether the beta-based investment strategy using on the negative geopolitical Black Swan is compared to a similar beta-based investment strategy, but which is instead applied to all Black Swans.

The findings imply that the theory behind the CAPM holds true for geopolitical risk, and so can be incorporated in the idea of systematic risk. Across the study period, assets with a low average beta value are on average less sensitive to geopolitical risk, while assets with a high-beta value are on average more sensitive to geopolitical risk. However, based on the findings of the study, it seems that beta is a good risk measure for geopolitical risk, at least for large and unexpected market declines due to geopolitical risk.

This study found that beta appears to be a useful tool for portfolio selection at least in terms of identifying portfolios that increase more than the market after a negative geopolitical Black Swan and decline less than the market after the following positive Black Swan. According to the results in this study, such a strategy is likely to outperform the EURO STOXX 50 index in the long-run as it did in this study.

The underlying idea of the constructed beta-based portfolio strategy is that it tries to take advantage of the theory of mean reversion. Further, the portfolio strategy outperforms the benchmark which makes mean reversion a contributing explanation for the excess returns, it is reasonable to consider that EURO STOXX 50 index have a mean-reverting behavior. On the other hand, this paper was not attempting to show specifically the existence of mean-reversion on the EURO STOXX 50 index, only that there is an indicating mean-reverting

behavior. The results of this study also seem to show that the phenomenon of speed of reversion is a particularly important and crucial component when designing a beta-based Black Swan strategy.

For further research it would be interesting to broaden the study and may gain additional excess returns. In this study, mean reversion is assumed rather than proven; however, if mean reversion were further examined by investigating the speed of reversion and its relationship to the magnitude of a Black Swan, it may be possible to develop a more advantageous definition of a Black Swan.

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Appendix: Companies Analyzed in the Paper

Table A: High-Beta Companies

Company name	Industry	Country
Aegon, NV	Financials	Netherlands
Ageas, SA/NV	Financials	Belgium
Airbus, SE	Industrials	Netherlands
Alcatel-Lucent, SAS	Telecommunication	France
Allianz, SE	Financials	Germany
Alstom, SA	Industrials	France
ArcelorMittal, SA	Materials	Luxembourg
ASML Holding, NV	Information Technology	Netherlands
AXA, SA	Financials	France
Banco Bilbao Vizcaya Argentaria, SA	Financials	Spain
Banco Santander, SA	Financials	Spain
BNP Paribas, SA	Financials	France
Compagnie de Saint-Gobain, SA	Industrials	France
Credit Agricole, SA	Financials	France
CRH, Plc	Materials	Ireland
Deutsche Bank, AG	Financials	Germany
Deutsche Telekom, AG	Telecommunication	Germany
ING Groep, NV	Financials	Netherlands
Intesa Sanpaolo, SpA	Financials	Italy
Koninklijke Philips, NV	Healthcare	Netherlands
LVMH Moet Hennessy Louis Vuitton, SE	Consumer Discretionary	France
Mercedes-Benz Group, AG	Consumer Discretionary	Germany
Nokia, Oyj	Telecommunication	Finland
Orange, SA	Communication Services	France
Renault	Consumer Discretionary	France
Safran, SA	Industrials	France
Schneider Electric, SE	Industrials	France
Societe Generale, SA	Financials	France
Societe Lyonnaise Des Eaux Et De L´eclairage	Utilities	France
Stellantis, NV	Consumer Discretionary	Netherlands
Telefonica, SA	Telecommunication	Spain
TIM, SpA	Telecommunication	Italy
UniCredit, SpA	Financials	Italy
Vinci, SA	Industrials	France
Vivendi, SE	Communication Services	France
Volkswagen, AG	Consumer Discretionary	Germany

Table B: Low-Beta Companies

Company name	Industry	Country
Adidas, AG	Consumer Discretionary	Germany
Air Liquide, SA	Materials	France
Amadeus IT Group, SA	Information Technology	Spain
Anheuser-Busch InBev, SA/NV	Consumer Staples	Belgium
Assicurazioni Generali, SpA	Financial	Italy
BASF, SE	Materials	Germany
Carrefour, SA	Consumer Staples	France
Compagnie de Saint-Gobain, SA	Industrials	France
Danone, SA	Consumer Staples	France
Deutsche Boerse, AG	Financials	Germany
Deutsche Post, AG	Industrials	Germany
Deutsche Telekom, AG	Telecommunication	Germany
Endesa, SA	Utilities	Spain
Enel, SpA	Utilities	Italy
Eni S.p.A.	Energy	Italy
E.ON, SE	Utilities	Germany
EssilorLuxottica, SA	Consumer Discretionary	France
Fresenius SE & Co, KGaA	Health Care	Germany
Iberdrola, SA	Utilities	Spain
Industria de Diseno Textil, S.A.	Consumer Discretionary	Spain
Kone, Oyj	Industrials	Finland
Koninklijke Ahold Delhaize, NV	Consumer Staples	Netherlands
Lafarge, SA	Industrials	France
Munich Re	Financials	Germany
Orange, SA	Communication Services	France
Pernod Ricard, SA	Consumer Staples	Germany
Repsol, SA	Energy	Spain
Royal Dutch Petroleum Company	Energy	Netherlands
RWE, AG	Utilities	Germany
Sanofi	Healthcare	France
SAP, SE	Information Technology	Germany
Schneider Electric, SE	Industrials	France
Societe Lyonnaise Des Eaux Et De L´eclairage	Utilities	France
L'Oreal, SA	Consumer Staples	France
Telecom Italia, SpA	Communication Services	Italy
Unilever	Consumer Staples	Netherlands
Universal Music Group, NV	Communication Services	Netherlands
Vinci, SA	Industrials	France
Vivendi, SE	Communication Services	France
Volkswagen, AG	Consumer Discretionary	Germany
Vonovia, SE	Real Estate	Germany