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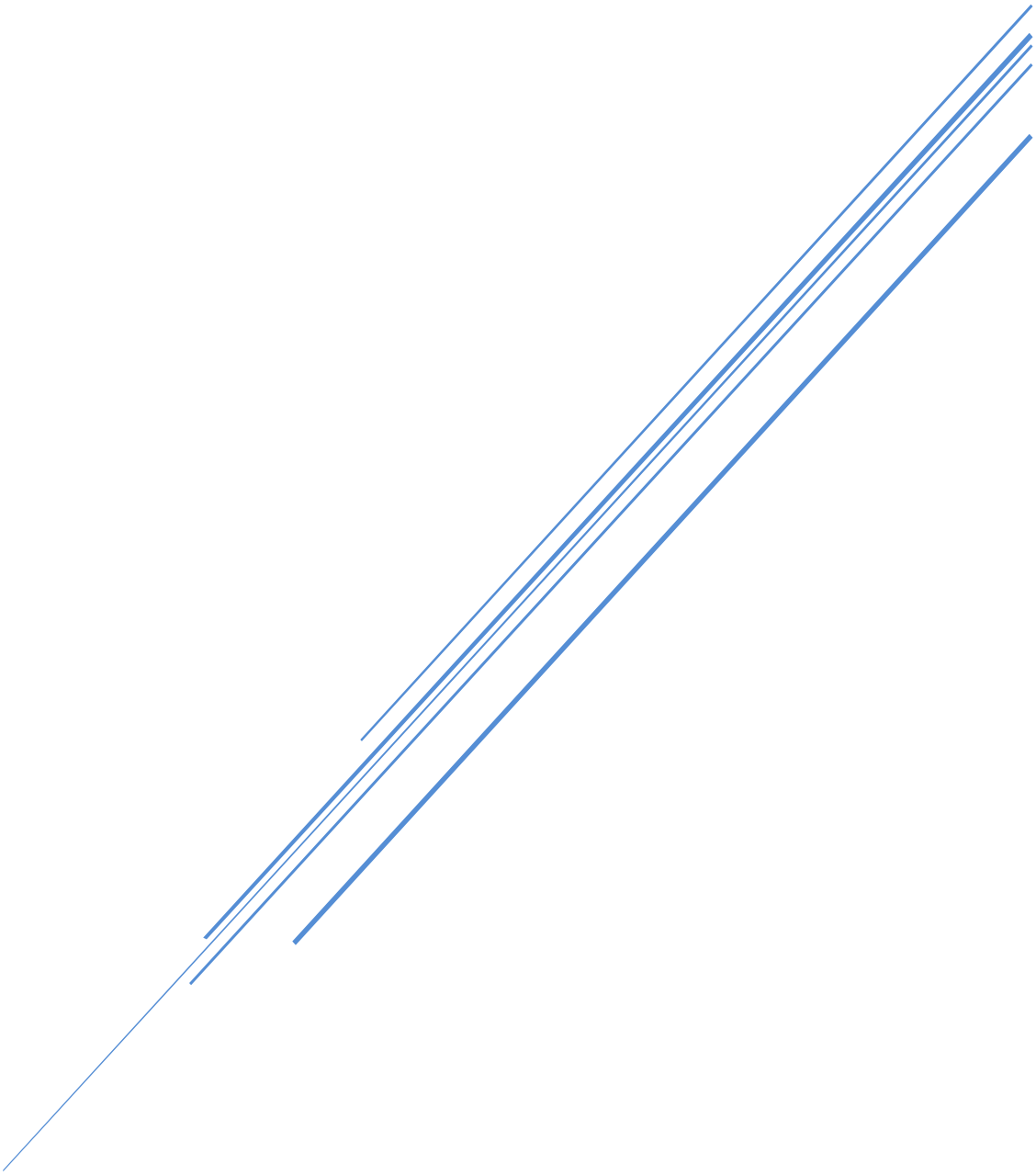
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1 Abstract

This paper has analyzed if there are effects of index inclusion that may be capitalized on in the S&P 500 and STOXX Europe 600. The Index Inclusion Effect is defined as the effect a stock experiences when included in an index. Previous scientific paper and trading theories are presented in order to establish a theoretical framework to analyze our findings. The consensus in the literature seems to be that stocks experience abnormal returns upon announcement day, but that this effect also holds true in the time around inclusion day. The literature suggests that this is mainly caused by increased investor awareness and price pressure. With the purpose of analyzing this further, and to answer the research question, data from all inclusions and exclusions between 2019 and November 2020 were retrieved. The data were split into four strategies, one long and one short for each index. The stocks were further analyzed by measuring performance from five days before inclusion day until ten days after. Daily movements, volume, and Sharpe ratio were also measured using the data. To supplement the analysis a t-test was performed in which we evaluated which of the strategies had positive expected returns on a statistically significant level. The findings suggest that there are clear signs of the Index Inclusion Effect on the inclusion date in both STOXX and S&P. Consequently, stocks tend to rise subsequent to their inclusion and fall if excluded. Furthermore, the findings suggest that stocks included outperform their respective indices in the chosen timeframe. The opposite is true for the excluded companies which tend to underperform relative to their respective indices. However, when adjusted for the indices' return, and statistical significance, most of the strategies seem unreliable. Nevertheless, going long on the companies being included in the STOXX 600 seems to be the most prominent strategy and the best way to capitalize on the index inclusion effect.

2 Introduction

Upon the recent announcement of Tesla Inc's inclusion into the S&P 500 index, the stock soared 8% (Mackenzie & Platt, 2020). In the literature, this short-term increase in stock valuation - as a result of index inclusion - is regarded as the Index Inclusion Effect (Elliot et al, 2006). The fact that Tesla's appreciation in price occurred despite the company's fundamentals remaining unchanged, illustrates the considerable opportunities this effect poses for the active investor. This raises the question of how investors may capitalize on the mentioned effect.

In addition to this, the paper will identify possible explanations for the effect in order to recognize where and when the effect occurs. This knowledge may help us determine how one can compose a strategy to capitalize on the effect. In short, we seek to determine if this effect occurs on the S&P 500, and whether similar effects are present on the STOXX Europe 600. Consequently, this paper aims to analyze the following research question:

Are there effects of index inclusion that may be capitalized on in the S&P 500 and STOXX Europe 600?

Firstly, the paper will introduce the relevant theoretical framework needed to answer the research question, namely scientific literature on the Index Inclusion Effect as well as the chosen indices. Secondly, the methodology used to perform our analysis will be explained. Thirdly, a reflection of the main findings and discussion of potential limitations of our methodology and findings will be presented. Lastly, a conclusion to the research question will be made, based on the analysis.

3 Literature and Theory

To understand the effects of index inclusion, and to answer our research question, papers on the index inclusion effect will be presented. Furthermore, we will present general trading theory, the chosen indices, and information regarding the behavior of index funds.

3.1 Literature on the Index Inclusion Effect

As a clear definition is seemingly lacking in the scientific literature, we choose to define the Index Inclusion Effect as the effect a stock experiences when included in an index. Several

studies have revealed that some stocks experience significantly higher returns after being included in larger indices like the S&P 500 (Hacibedel & Bommel, 2007).

There are several studies with different approaches to why this effect occurs. Elliot et al. (2006) investigated several possible drivers for this effect, by looking at the performance of stocks being included in the S&P 500 and measuring the different drivers for each respective stock. They found that the stocks experienced the largest return on the announcement date and that most of this return was caused by increased stock awareness. Another study by Biktimirow & Xu (2019) supports the idea of stock awareness increasing stock performance. Their study analyzed inclusions in the Nasdaq 100 index and found that increased investor awareness was the main driver for increased return. The researchers also found that only first-time inclusions, not delisting or repeated inclusions, showed a significant increase in investor awareness. Furthermore, these stocks also experienced long term price improvement and significantly increased returns. Biktimirow & Xu's (2019) findings are further supported by Chen et al. (2005) who found that the investor awareness effect only applies to companies being included, not delisted. They found that stocks being included experienced a permanent price increase and that the delisted companies experienced no permanent price change. Lastly, a study by Kasch & Sarkar (2012) found a significant increase in stock returns between the announcement date and inclusion date.

Elliot et al. (2006) similarly found that price pressure did have some effect on stock returns in the time around the inclusion date. However, the effect was much weaker than the effect of increased investor awareness. Furthermore, Shleifer (1986) found that stocks experienced elevated returns in the ten days following the inclusion date. The study also found a correlation between buy-volume from index funds and the increased returns of the stocks.

Yet not all studies agree that there is a positive effect associated with index inclusion. A study conducted by Bennet et al. (2020) found that stocks included in the S&P 500 in the period between 2008 and 2017 did not experience increased returns around the announcement date. Moreover, they found that stocks experienced a negative return over a 12-month time frame. On the other hand, they found that an increasing number of passive investors, such as mutual funds, were buying stocks around their respective inclusion dates. However, when they analyzed the same effect between 1997 and 2007, they found different results. In the time frame

between 1997-2007 they found significantly increased returns around the announcement date, but insignificant returns around the announcement day in the years 2008-2017.

3.2 General Trading Theory

3.2.1 Informed Traders

Informed traders estimate fundamental value based on publicly known information and on privately acquired information that only they can access (Harris, 2003, p. 226). Based on these pieces of information, they estimate whether an instrument is undervalued, correctly priced, or overvalued, and consequently buy the undervalued assets and sell overvalued assets. Informed traders possess an advantage whenever they have acquired information that is not publicly known.

3.2.2 News Traders

News traders collect and act upon new information about an instrument trying to predict the value and whether the price will rise or fall (Harris, 2003, p. 229). A type of information that is important to news traders is material information, this information significantly affects value. News traders often seek to be the first to discover this type of information. This provides them with an advantage, allowing them to act early on the news.

3.3 Insights into the Indices

Market indices are hypothetical portfolios of securities meant to represent a specific market or a segment of it (Johnson, 2019). Stock market indices are used as benchmarks for the stock market and differ greatly in their coverage. Moreover, indices have different methodologies when it comes to how securities are weighted and what criteria they will have to meet in order to be included.

3.3.1 S&P 500

The S&P 500 is a stock index that consists of 500 of the largest companies in the US (S&P Global, 2020). The index is a market capitalization-weighted index, meaning that companies are weighted according to their market cap. Moreover, the index is float-weighted which implies that the market capitalization of a company is adjusted to the number of outstanding shares in the market. The most relevant prerequisites a stock has to meet to be eligible for inclusion, are that the company should have a market cap of USD 8.2 billion, be highly liquid,

have at least 50% of its shares available for public trading, and four consecutive quarters of positive earnings. Furthermore, the S&P 500 rebalances its composition of companies and weighting once every quarter.

3.3.2 STOXX Europe 600

STOXX Europe 600 is an index comprising 600 companies from a list of 18 European countries. The index includes the 600 largest companies in these countries measured by free-float market cap (STOXX, 2020). The composition of the index is changed four times per year with the announcement being on the first workday of March, June, September, and December each year. The inclusions and exclusions will normally happen on a Monday three weeks following the announcement. Unlike S&P 500, few index funds are tracking the STOXX. However, there are some Exchange Traded Funds (ETFs) tracking the index (STOXX, 2020).

3.4 Index Funds

Index funds are portfolios designed to replicate the performance of the index it tracks. Indexing is a form of passive investment management, where there is a lower degree of asset turnover (Harris, 2003, p. 97). Index funds can either be open-end mutual funds or ETFs.

Passive index funds aim to replicate the index they are following by holding a percentage of each company in their portfolio, equal to the share the respective companies represent on the index (Vanguard, 2020). The index funds will have to weigh the new company into their portfolio equal to the share the company has on the relevant index. This may force them to buy stocks regardless of the current price.

In addition to passive index investing, there are actively managed index funds as well (Vanguard, 2020). These active index funds usually combine the passive investing strategy of a normal index fund with a share of active management to increase the returns relative to the index. Another aspect of actively managed index funds is that they have the possibility to front-run the index inclusion dates on the companies that are about to be included (E. Framnes, personal communication, November 2, 2020).

4 Methodology

4.1 Expectations

The consensus in the literature seems to imply that there are increased returns associated with index inclusion. The most significant returns seem to be on and between the announcement date and inclusion date, nonetheless, other studies have also suggested that there are increased returns in a short timeframe after the inclusion date. The increased awareness of the stocks seems to be the main driver for the announcement-returns, however, there are some indications of buying-pressure in the time around inclusion too (Elliot et al., 2006). Based on this knowledge, we expect to see increased returns from announcement day until a few days after inclusion. These expectations suggest that there might be an opportunity to capitalize on the short-term returns on these stocks.

Nevertheless, we deemed it unlikely that we would be able to profit from trading stocks on the announcement day. The reasoning behind this was derived from the assumption that news traders would be likely acquire the information regarding the announcement before us. As a result, making it hard for us to obtain the stocks at favorable prices due to heavy competition. Additionally, we recognized the notion that informed traders, based on fundamental evaluations, may have anticipated these inclusions in advance, thus increasing the number of professional traders able to front-run us. To avoid the implications of the aforementioned factors, we have chosen to limit our strategy to the time right before, and after the inclusion date. Ultimately, the expectation based on the presented literature is that it might be possible to profit from the movements around the inclusion date.

4.2 Method

The data for the analysis has been gathered from companies about to be included or excluded from one of the chosen indices. Resultantly, we have collected data regarding 122 inclusions/exclusions on the STOXX, as well as 50 on the S&P. The data has been retrieved from Yahoo Finance and formatted to fit our purpose (Yahoo Finance, 2020).

The data collected enabled us to analyze the returns from several inclusions, and different time intervals. Based on the studies cited in the theory we have chosen to analyze the cumulative returns from five days before inclusion, until ten days following inclusion. By examining how significant our findings are and comparing them to the index, we may be able to decide if there

are effects of index inclusion/exclusion within the stock's performance. Our strategy includes opening a long position in the companies included and opening a short position in the excluded companies. The strategy is based on the theory claiming that the effects of index- inclusion and exclusion are not prolonged, meaning we had to capture the effects within a short timeframe. The mentioned time frame covers both the effects of possible front-running by actively managed index-funds, while additionally taking into consideration the findings of Shleifer (1986), which suggests increased returns in the ten days following inclusion.

Figure 1 illustrates a sample of our data collection. The figure contains data on specific companies about to be listed on the STOXX 600 for a given time frame and their returns before and after inclusion. Day 5 illustrates five days before inclusion, day 0 is the inclusion day itself, and day -10 is ten days after inclusion. The chart illustrates daily returns based on close-to-close price, except for day 5 which is based on open to close. In addition to the data about specific companies, the average movement of the companies and STOXX 600 is also illustrated in Figure 1.

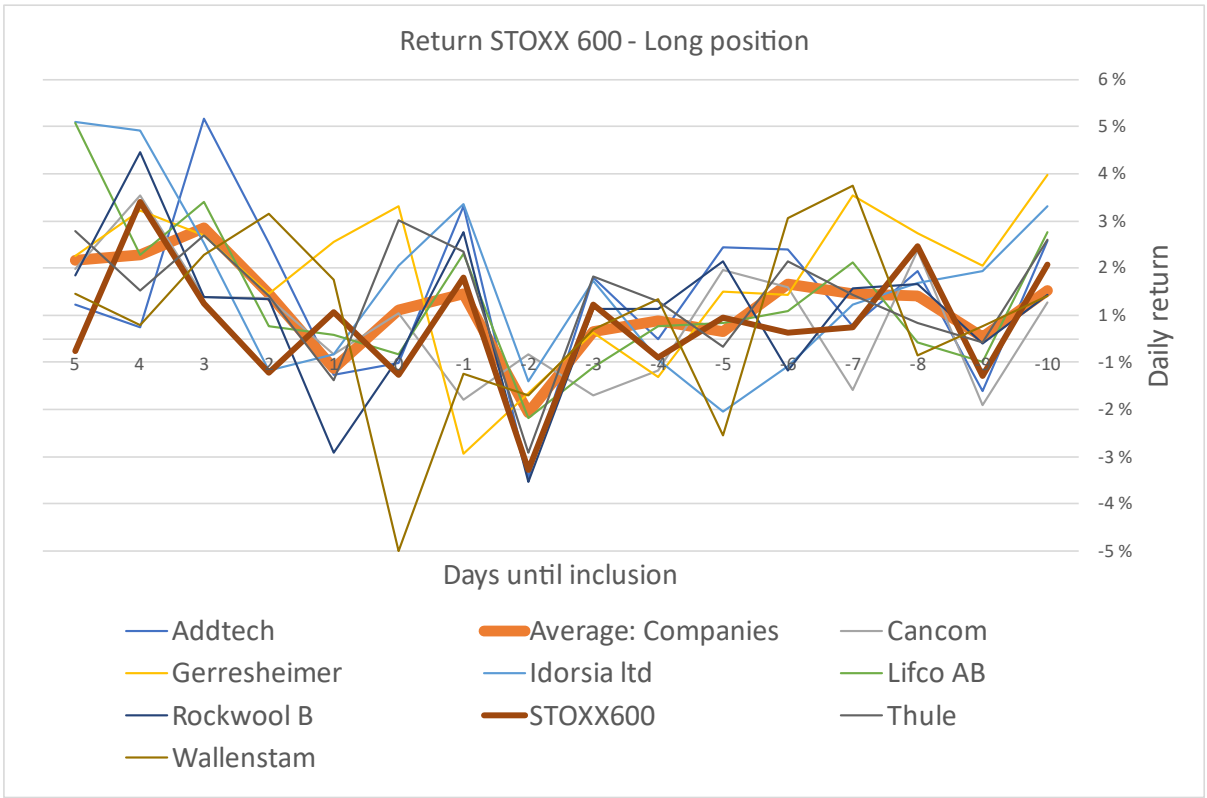


Figure 1 - Return STOXX 600 - long position. Sample of data

To isolate the effects of the strategy we have split it into four parts, in which we analyzed both short- and long positions in the two respective indices. Additionally, we have excluded the inclusions in STOXX on March 23, 2020, due to the extreme volatility caused by the Covid-19 situation. Volatility was on such high levels that we considered it improbable for an active investor to pursue a short-term strategy during such stressed market conditions. Excluding data will reduce the quality of the analysis and weaken our findings. However, we believe the inclusion of data from March would severely impact our data due to the short time frame. Furthermore, the fact that a correction - like the one Covid-19 caused - only occurs occasionally, implies that a larger dataset spanning a bigger timeframe would eventually even out the movements caused by it. Therefore, due to our limited data from the last two years, we choose to exclude the mentioned period. For the S&P 500, the problem is not as pressing, seeing as there were no inclusions in March 2020, and only two exclusions on March 31, 2020, when market conditions were more stable (S&P Dow Jones Indices, 2020). Furthermore, we have observed that there are fewer observations of companies being excluded than included. This has to do with a lack of data in some of the companies being excluded subsequent to their exclusion.

4.2.1 Sharpe Ratio

To measure risk-adjusted returns, the Sharpe ratio is utilized. The ratio measures the return on an investment per risk unit. To compute it we find the average return earned in excess of the risk-free rate, divided by the volatility in the portfolio. Excess returns are the excess returns from one or several inclusion/exclusion events. Resultantly, the volatility is measured as the standard deviation of the average excess returns. We utilize the German 1 Year Treasury Yield for STOXX Europe 600, and the American 1 Year Treasury Yield for S&P 500, as our risk-free rates (Bloomberg, 2020).

$$Sharpe\ Ratio = \frac{R_p - R_f}{\sigma_p}$$

4.2.2 P-value

P-value is a statistical measure utilized in hypothesis testing to determine the statistical significance of findings (Biau, Jolles, & Porcher, 2010). In practical terms, it measures the

probability of observed results being as extreme or more extreme given that the null hypothesis is correct. A p-value of 0.02 does for instance imply that there is a 2% likelihood of rejecting the null hypothesis in instances in which it is true. The threshold for rejecting the null hypothesis in favor of the alternative hypothesis (hereby confidence interval) is usually set at a p-value of ≤0.05, meaning that in 1/20 cases we will end up rejecting the null hypothesis on a false positive.

4.2.3 T-test

A t-test is a statistical test whose purpose is to infer whether there is a significant difference between the means of two populations (Siegle, 2020). In practical terms, this test looks at the difference of computed means from two datasets. Consequently, in our analysis, we will utilize a one-tailed t-test to determine whether the mean returns of our strategies are greater than 0% at a statistically significant level. A one-tailed t-test will try to determine whether one mean is greater or less than the other mean. As displayed in the equation below the null hypothesis of the one-tailed t-test we will be performing is that the mean returns of the respective strategies are less or equal to 0%. The alternative hypothesis, which is what we seek to prove by rejecting the null hypothesis at the 0.05 p-value level, states that the mean returns of the respective strategies are positive.

$$\text{One-tailed t-test} \quad H_0: \mu_{strategy} \leq 0\% \quad H_1: \mu_{strategy} > 0\%$$

Moving on, it is important to stress that a prerequisite for utilizing this test, is that certain criteria are met, namely the following assumptions: Firstly, the data must follow an ordinal or continuous scale and there must be homogeneity of variance (Tae & Park, 2019). Moreover, the sample must be randomly selected and representative of the population it seeks to infer something about. Lastly, the observations should resemble a normal distribution when plotted.

5 Analysis

The analysis will present findings related to our strategy and compare them to the respective indices included in this paper. Furthermore, the comparisons will help answer our research question and determine whether buying a company included or excluded from an index provides abnormal returns in the short time-period before and after the inclusion. The analysis

is split into two parts; S&P 500, and STOXX 600. Firstly, we will present the average daily return, accrued growth, and volume to analyze the stock movements in the mentioned period. Secondly, we will adjust our findings to the respective indices' performance. Lastly, we will use the Sharpe ratio and statistical analysis to evaluate the strategies.

5.1 S&P 500

5.1.1 Average Daily Return

In the period examined in our long and short portfolio, figure 2 illustrates the average daily return for the S&P 500 long and short strategy. The dark-blue line represents the absolute movements of the long-strategy while the light-blue represents the short-strategy. The volume is marked grey for the long stocks and blue for the short stocks. The graphs illustrate the movements between each respective trading day around inclusion day. It is important to notice that for the short strategies, all returns are inverted, meaning that a 5% growth represents a 5% decline in the underlying asset.

As is present in figure 2, there are notable price movements in each respective direction on the inclusion date. The stocks being included experience increased returns while excluded stocks experience negative returns. According to the presented literature, announcement day is the day with the largest price movements. Yet, our findings suggest that the inclusion day itself leads to large movements in the expected direction as well. Additionally, the movements in the short portfolio are larger on exclusion day than the long portfolio. When comparing the graphs, it is evident that the short-strategy experiences a much larger increase than the long-strategy between trading days 1 and 0. For the remaining trading days, the results vary a lot. The movements are notably smaller in the long strategy than the short strategy, but the trend following the inclusion date is clearer for the long-strategy.

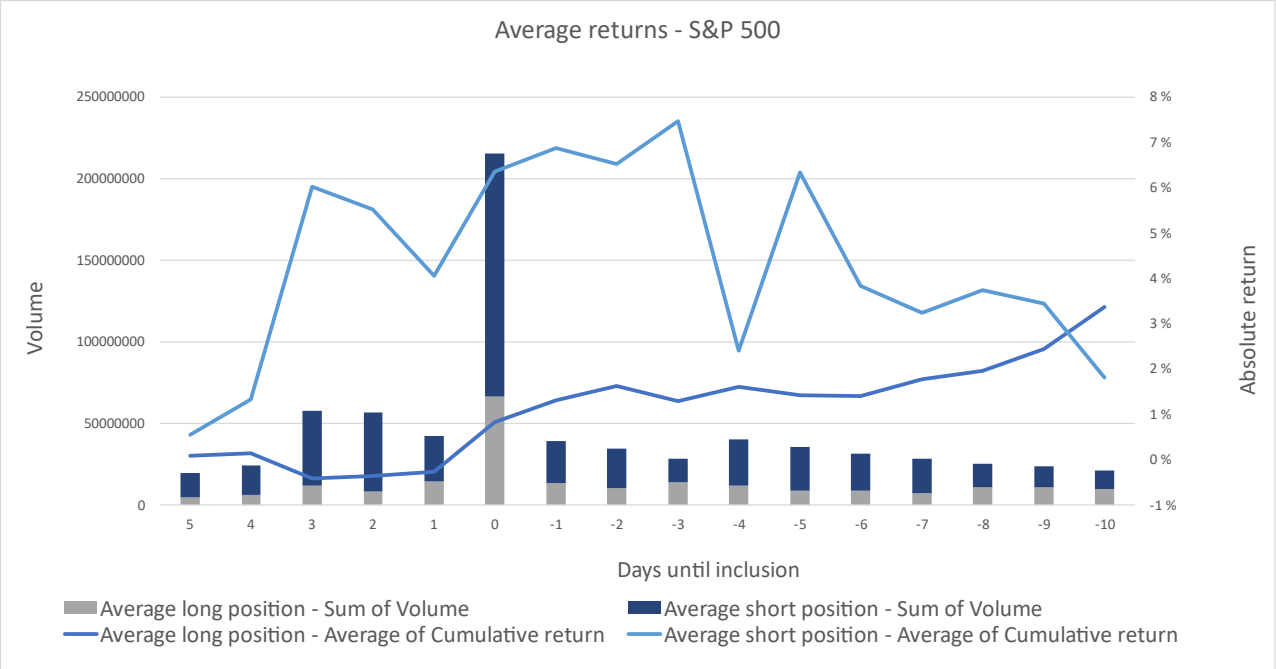


Figure 2 - Total average cumulative returns - S&P 500

5.1.2 Volume

As illustrated by the blue and gray pillars in figure 2, the volume is significantly larger on the inclusion day compared to all other trading days in the analysis. The volume is approximately four times larger on inclusion day compared to the average volume for the respective period. Moreover, this strengthens the price movements on the inclusion date, since the increased volume may be a sign of strength in the movement (Gagnon & Karolyi, 2009). Furthermore, the volume is somewhat larger on the days before the inclusion, while the price movements show no clear direction. In total, both the volume and price movement suggest that investors are moving assets into the stocks being included and moving out of those being excluded in the time around the inclusion date.

5.1.3 Cumulative Growth

In effect, we are able to measure the average return on our strategies for each strategy. For the long strategy, cumulative growth was 3.37%. For the short strategy, the cumulative growth was 1.81%. These findings are also present in Figure 2 as the results are illustrated in trading day -10. Our findings, therefore, suggest that both the short- and the long-strategy ends with a positive return. These findings initially strengthen the theory of the Index Inclusion Effect since we find a positive return in the following 10 days as Shleifer (1986) found. Likewise, we observe a price depreciation in the excluded companies. These findings suggest that it is possible to profit from the Index Inclusion Effect by going long on included companies 5 days

before inclusion and selling 10 days after. The same is also true for the stocks being excluded, where our findings suggest that it is possible to profit from opening short positions 5 days prior to exclusion end closing them 10 days after.

5.1.4 Index-Adjusted Returns

However, the results may be altered when factoring in S&P 500s movements. Therefore, analyzing the returns against the price movements of the S&P 500 index itself is necessary. Figure 3 illustrates the average cumulative growth of the strategies, adjusted for the movements of the S&P 500. The index adjusted long position is illustrated by the gray graph and provides a return of about 1%, which is substantially lower than without index adjusting. Comparing the returns against the index severely limits the positive returns of the companies included, and they barely become profitable. This is caused by overall growth in the S&P 500 in the same period (S&P Dow Jones Indices, 2020). The short-strategy, however, is not relevant to index-adjust. The strategy will only yield a positive return when the stocks drop below zero, thus a positive return on the S&P 500 will mislead investors thinking that the short-strategy yields more than it does. For example, if the short-strategy yields a 0% return in a given time frame, while the index itself grows by -10%, our strategy would yield a 10% positive return compared to the index, when it in reality has not been delivering absolute returns at all. Consequently, it is more appropriate to compare the short-positions to their original value.

However, the effect on inclusion date is still persistent when adjusted for the index' movements. Even though the long-strategy seems to be unreliable when adjusted for the index, the findings suggest two possible ways to profit from the index inclusion effect in the S&P 500 index. First, the short-strategy seems to be able to provide positive results in our analysis. Secondly, one can buy, or sell for short, the day before inclusion day and then sell at close on inclusion day to capitalize on the immediate effect on inclusion day. In short, even when adjusted for index performance, it is evident that the effect still occurs on the inclusion

date, thus giving investors the opportunity to generate a small profit from trading it.

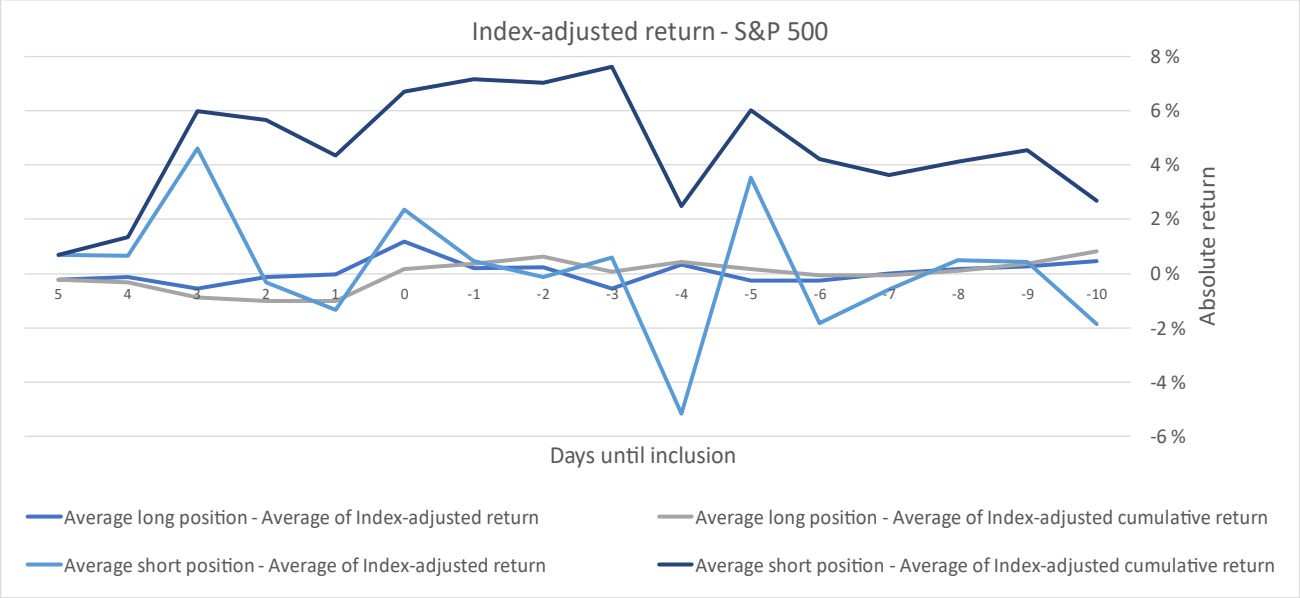


Figure 3 - Total average index-adjusted returns - S&P 500

5.1.5 Sharpe Ratio

In order to measure the risk-adjusted returns on the strategy for S&P 500, the Sharpe ratio is utilized. The main findings revolve around largely divergent returns resulting in differing ratios. Additionally, the short timespan may cause irregular standard deviations. To prevent this, we have grouped the results semi-annually for S&P 500, resulting in smaller standard deviations.

However, if one were to replicate the strategy for the S&P 500, for 2019 and 2020, a *Sharpe Ratio of 1.62* would be achieved for the long-strategy, and a *ratio of 0.16* would be achieved for the short-strategy. The low ratio for the short-strategy is caused by the differing excess returns, resulting in a low risk-adjusted return. Nevertheless, the long-strategy seems to result in a fairly high Sharpe ratio, implying that it may be a good investment. Altogether the long-strategy seems to outperform the short.

Period	Return	10y US Treasury Yield	Excess return			
Q1-Q2 2019	5.18 %	0.84 %	4.34 %		**Std.dev of excess returns**	0.01566
Q3-Q4 2019	2.51 %	0.84 %	1.67 %		**Average excess return**	2.53 %
2020	2.42 %	0.84 %	1.58 %			
					Sharpe Ratio	1.62

Figure 4 - Sharpe ratio for long-strategy - S&P 500

Period	Return	10y US Treasury Yield	Excess return
Q1-Q2 2019	-7.44 %	0.84 %	-8.28 %
Q3-Q4 2019	2.10 %	0.84 %	1.26 %
2020	12.52 %	0.84 %	11.68 %

Std.dev of excess returns	0.09986
Average excess return	1.55 %
Sharpe Ratio	0.16

Figure 5 - Sharpe ratio for short-strategy - S&P 500

5.1.6 Statistical Analysis

As is evident from figure 6 below, both the long- and short-strategies of S&P 500 seem to resemble a normal distribution. The returns on the S&P 500 long strategy seems to have no apparent skew and outliers of similar impact. The short strategy, however, has a slightly positive skew and a considerable outlier on the positive side which considerably impacts its mean return.

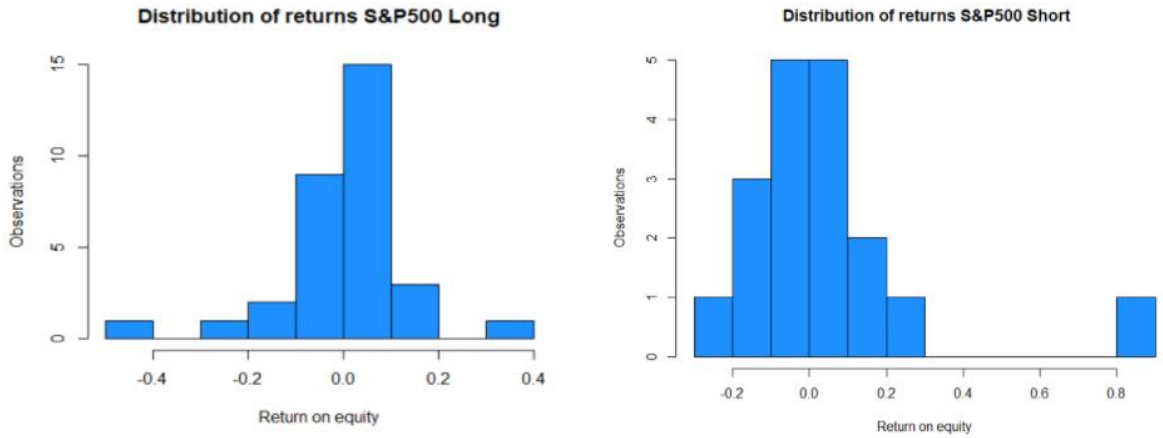


Figure 6: Distribution of returns S&P 500 long- and short-strategies

Before assessing the data, it is important to note that computed means in the statistical tests are based on the average performance of each individual stock rather than the mean of each period. Consequently, the numbers observed in the statistical tests performed on the S&P and STOXX will differ from the ones in their earlier sections. Moving on, it is apparent from figure 7 that both strategies do not have expected mean returns that are positive on a statistically significant level. The long strategy has a mean return of 2.97% and a median return of 0.7%, while the short strategy has 4.08% mean returns and a median return of 3.7%. Counterintuitively, the better performing strategy of the two, is the one in which the null hypothesis cannot be rejected. Only the long strategy with its p-value of 0.008 is therefore yielding positive returns on a statically significant level, while the short strategy's p-value of 0.225 implies that the strategy

cannot be expected to yield positive returns on a statistically significant level. The high p-value of the short strategy has to do with the strategy having fewer observations than its counterpart.

Strategy	Average return on equity	Median return on equity	One tailed t-test	P-value
S&P500 Long	2.97%	0.7%	$H_0: \mu \leq 0\%$ $H_1: \mu > 0\%$	0.008
S&P500 Short	4.08%	3.7%	$H_0: \mu \leq 0\%$ $H_1: \mu > 0\%$	0.225

Figure 7: T-test of returns for S&P long and short strategies.

Lastly, to factor in the opportunity cost of pursuing the different strategies we will test whether the strategies are significant when adjusted for index performance. As displayed in figure 8 none of the strategies are having expected mean returns that are positive on a statistically significant level. The performance of the long strategy has fallen drastically, thus increasing its p-value to 0.42. On the other hand, the short strategy sees a considerable improvement in both the p-value and the average return on equity. Nevertheless, as mentioned earlier, it is important to note that index adjustment cannot be considered an optimal way to account for opportunity cost in a short strategy.

Strategy	Average return on equity	One tailed t-test	P-value
S&P500 Long (index adjusted)	0.46%	$H_0: \mu \leq 0\%$ $H_1: \mu > 0\%$	0.42
S&P500 Short (index adjusted)	5%	$H_0: \mu \leq 0\%$ $H_1: \mu > 0\%$	0.089

Figure 8: T-test of index adjusted returns for S&P long and short strategies.

5.2 STOXX Europe 600

Figure 9 shows the average of our long and short positions on the STOXX Europe 600. Furthermore, it also shows the average volume traded for the companies being included and excluded from the index. In this figure, the short portfolio returns are inverted as well. Meaning that a 2% increase in these positions also shows that the price of the companies fell 2% on average.

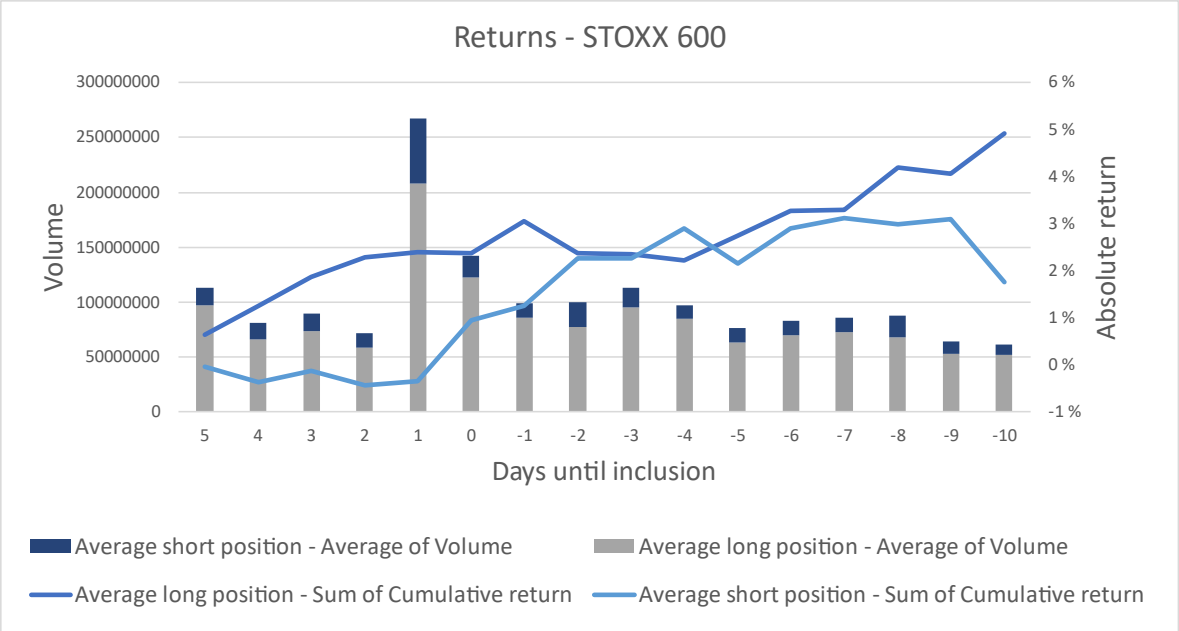


Figure 9 – Total average cumulative returns - STOXX 600

5.2.1 Average Daily Returns

In the examined time period of our long portfolio, illustrated in figure 9, there are no days that stand out in terms of unnatural growth. In the days leading up to inclusion, there is a trend of appreciation stopping at about 3% on the day after inclusion. However, we did not detect the same upward trend on the inclusion date as we did in the S&P. Furthermore, there was a new trend of growth a couple of days after the inclusion. As for our short position, we can see that there are very small changes in the days leading up to exclusion and that they are somewhat negative. However, when the companies are excluded, we observe that the returns in the following five trading days show an approximate 3.5% increase. It is evident that there are larger effects on the excluded companies than the included companies on the day of inclusion/exclusion. In addition, the last trading week shows few signs of movement in either direction. This might be due to the ETFs having sold their positions; thus, the stocks are no longer affected by the ETFs after the first week.

5.2.2 Volume

Interestingly, we can see that the average volume traded is about four times as high for included companies as for excluded companies. Since the index consists of companies from 18 different European countries, there is a chance that being included in the index promotes the company to foreign investors, thus increasing investor awareness.

Another interesting finding on the STOXX index is related to the trading volume of each individual stock, the day before inclusion. As seen in the charts, the volume on the day before inclusion is approximately three times higher than the average of the 16-day period we examined. A possible explanation might be ETFs front-running the inclusion date or buying the day before inclusion. Additionally, actively managed index funds might want to front-run the inclusion date and trade before the actual date. Nevertheless, there might be other reasons suited to explain this phenomenon. On the one hand, as mentioned, the effects of increased volume can be due to the increased awareness of the company. On the other hand, this trend is observable in both the included and the excluded companies, which means there has to be other factors than only investor awareness, causing the sudden increase in volume.

5.2.3 Cumulative Growth

In terms of cumulative growth in the long portfolio, the data shows promising results. At close on the inclusion day, the data shows a cumulative growth of 2.5%. In the next few days, cumulative growth decreases somewhat, but increases again a week after inclusion, with returns at the end of the sixteen-day period at approximately 5% on average.

The returns of the short-strategy start to show on the day of the exclusion. There is a possibility that the ETFs are forced to sell their holdings in the companies on this day, which initiates a price drop. This is further shown to have a negative impact on the stocks in the subsequent days, but a positive effect on our short position. After a few days, and the end of the trading week, the companies revere the trend somewhat and reduce their downside. The next trading week the companies remain quite unchanged and we see that on average these positions yield a 3% return. Furthermore, the reduced volatility on average may indicate that there is less trading in the second week for the stocks and that the funds are no longer invested in any of these companies.

5.2.4 Index-Adjusted Returns

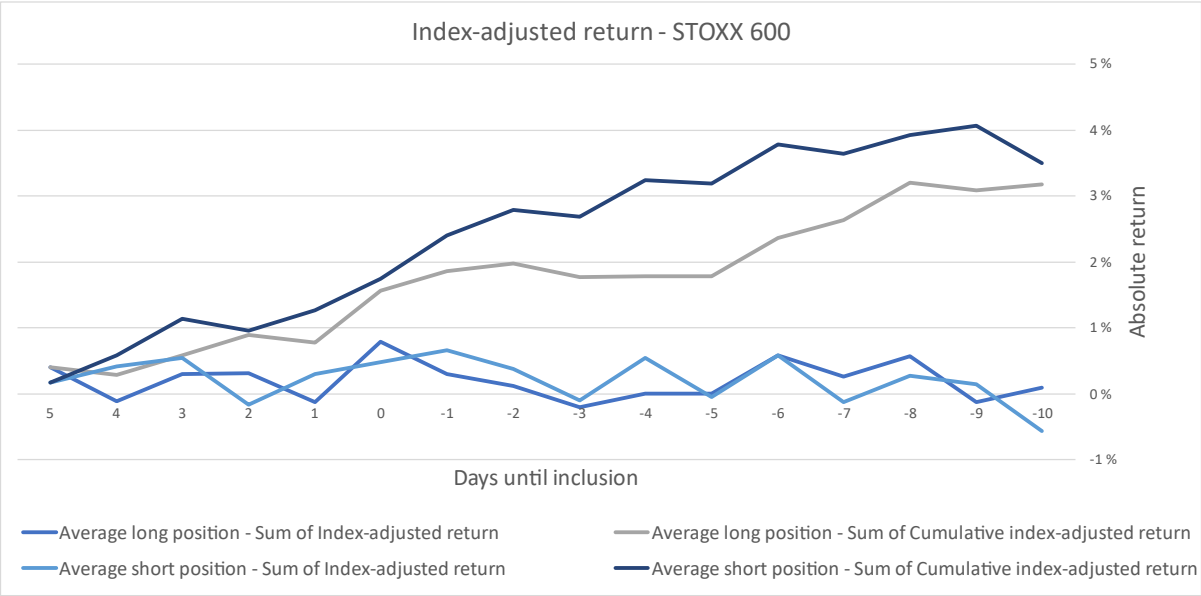


Figure 10 – Total average index-adjusted returns - STOXX 600

As we can see from figure 10, the index-adjusted returns are lower for our long position strategy but yield higher returns for our short strategy. This is natural seeing as the index has appreciated in the same time period. Just like with the S&P 500 findings, we do not adjust our short-position for the STOXX. Thus, our strategy provides a return of just under 2% on the short strategy, but 3.5% compared to the STOXX. Altogether it is an interesting finding that the included companies on average performed 3.5% better than the STOXX in the same period as the excluded companies performed 3.5% worse than the index. This indicates that there is a correlation between inclusion/exclusion and positive/negative returns.

5.2.5 Sharpe Ratio

The Sharpe ratios for the STOXX 600 seems to amplify our previous findings regarding a higher rate of risk-adjusted returns on the long-strategy against the short. With a *ratio of 1.34*, the long-strategy stands out from the short, with a *relatively low 0.54*. By solely looking at these ratios, the long-strategy seems to be preferable when assessing the risk associated with

the reward. Since we had more observations on the STOXX index, we were able to divide the data into quarters while still ensuring the integrity of our dataset.

Year	Period	Return	10 year German Treasury Yield	Excess return		
2019	Q1	3.58 %	-0.49 %	4.07 %		
2019	Q2	1.80 %	-0.49 %	2.29 %		
2019	Q3	6.48 %	-0.49 %	6.97 %	**Std.Dev of excess returns**	0.040451
2019	Q4	7.02 %	-0.49 %	7.51 %	**Average excess return**	5.40 %
2020	Q2	10.91 %	-0.49 %	11.40 %		
2020	Q3	-0.33 %	-0.49 %	0.16 %	**Sharpe ratio**	**1.34**

Figure 11 - Sharpe ratio for long-strategy - STOXX 600

Year	Period	Return	10 year German Treasury Yield	Excess return		
2019	Q1	4.57 %	-0.49 %	5.06 %		
2019	Q2	-6.44 %	-0.49 %	-5.95 %		
2019	Q3	4.52 %	-0.49 %	5.01 %	**Std.dev of excess returns**	0.041906
2019	Q4	1.56 %	-0.49 %	2.05 %	**Average excess return**	2.25 %
2020	Q2	2.52 %	-0.49 %	3.01 %		
2020	Q3	3.85 %	-0.49 %	4.34 %	**Sharpe ratio**	**0.54**

Figure 12 - Sharpe ratio for short-strategy - STOXX 600

5.2.6 Statistical Analysis

Regarding the distribution of results in the STOXX long and short strategies, it is evident from figure 13 that the long strategy has a considerable positive skew with few outliers. The short strategy, on the other hand, has a moderate positive with one considerable outlier.

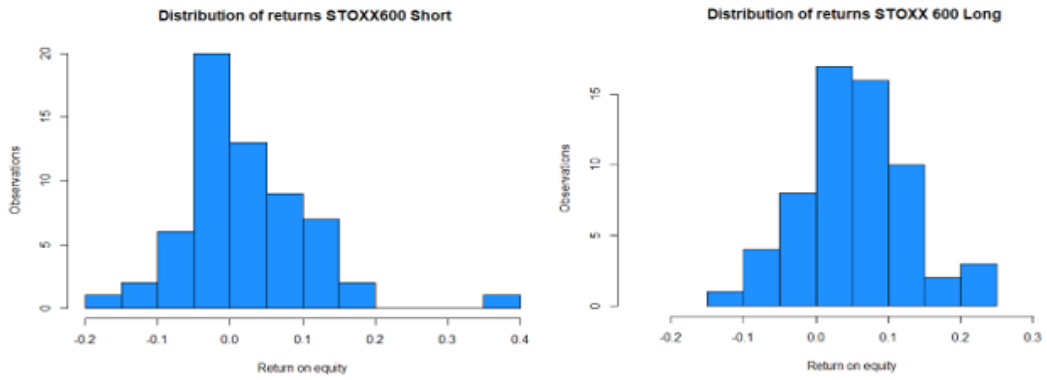


Figure 13: Distribution of returns STOXX long- and short-strategies

Moving on, when performing a one-tailed t-test on the strategies it becomes apparent from figure 14 that the STOXX long strategy is the top performer delivering an average return of 5.41% with a median return of 3%. Moreover, with a p-value of 3.8e-07, the mean expected returns of the strategy is positive on a statistically significant level. The short strategy, on the

other hand, has average returns of 1.76% and a p-value of 0.059, meaning that it is close to the 0.05 threshold, yet not low enough for us to reject the null hypothesis.

Strategy	Average return on equity	Median return on equity	One tailed t-test	P-value
Stoxx600 Long	5.41%	3%	H_0: $\mu \leq 0\%$ H_1: $\mu > 0\%$	3.80e-07
Stoxx600 Short	1.76%	0.9%	H_0: $\mu \leq 0\%$ H_1: $\mu > 0\%$	0.059

Figure 14: T-test of STOXX long- and short-strategies

To account for the opportunity cost of pursuing these strategies, both strategies will have their index adjusted returns t-tested. As illustrated in figure 15, both strategies have positive expected index adjusted returns on a 95% confidence level, with the short strategy being the top performer. Additionally, the effect of index adjustment seems to be negative for the long strategy, reducing its performance. The short strategy's returns, however, are helped by being index adjusted. Nonetheless, as mentioned earlier, index adjustment is not an optimal way to account for the opportunity cost of a short strategy.

Strategy	Average return on equity	One tailed t-test	P-value
Stoxx600 Long (index adjusted)	3.49%	H_0: $\mu \leq 0\%$ H_1: $\mu > 0\%$	0.00154
Stoxx600 Short (Index adjusted)	3.7%	H_0: $\mu \leq 0\%$ H_1: $\mu > 0\%$	0.0189

Figure 15: T-test of index adjusted returns for STOXX long- and short-strategies

6 Limitations of the Study

The data collected does have its weaknesses. Firstly, the small sample size, especially for the S&P short-strategy, results in returns having to be considerable before the mean is recognized as greater than 0 on a statistically significant level. This issue could have been addressed by looking at a larger time interval thus increasing the sample size.

Secondly, regarding the applied time interval, it should be noted that a strategy's performance in a 2-year timeframe, is not necessarily indicative of it performing well in the subsequent 2-year period. To tackle this problem, the inclusion of a time frame spanning more than 10 years

could help testing the index inclusion effect over a wider array of market conditions, resultantly increasing the credibility of our findings. Additionally, the aforementioned measure would also better fulfill the assumptions of t-testing, seeing as the sample size would be more representative of the population. Further on, the Sharpe Ratio is also affected by the sample size, which may cause biased calculations. In addition, the risk-free rate applied is at an all-time low due to Covid-19 and uncertainty in the macro-economic perspective.

Thirdly, our selection of stocks may limit our analysis. We chose to exclude stocks listed on March 23, 2020, which may have affected our returns and weakened our findings. However, the results of the S&P 500 were not as affected by this incident since they had no inclusions in March 2020, but two exclusions. Lastly, we have not included any form of transaction costs or interest payment on our trades. Including these factors would definitely decrease our returns but would also add another layer of complexity to this paper.

7 Conclusion

In this paper, we have analyzed whether there are effects of index inclusion that one might be able to capitalize on in the S&P 500 and the STOXX Europe 600. The time period in focus has been 2019 to 2020, where we have excluded March 2020 in the STOXX analysis. After studying other papers, we decided to analyze the effects of entering positions five trading days before the inclusion date and closing the positions ten trading days following inclusion. Resultantly, we decided to investigate the returns when holding short or long positions in both the indices, giving us four different strategies to analyze.

By utilizing statistical analysis and risk measurement the paper was able to find the most prominent strategy. By holding a long position in stocks about to be included in the STOXX Europe 600, we found evidence that we were able to outperform the index with a Sharpe Ratio of 1.38 and average return on equity of These findings were also found to be statistically significant with the lowest p-value of the analysis, thus strengthening our claims. By holding a long position in stocks about to be included in the STOXX Europe 600, we found evidence that we were able to outperform the index with a Sharpe Ratio of 1.38 and average return on equity of 5.41%. These findings were also found to be statistically significant with the lowest p-value of the analysis, thus strengthening our claims.

In short, out of the four strategies we tested, only the STOXX and S&P long strategies proved to yield positive returns on a statistically significant level. However, when the returns were index adjusted only the long strategy applied on STOXX had positive returns with a p-value below 0.05. This indicates that the alternative cost of pursuing a long strategy on the S&P is higher than in STOXX. Consequently, our findings suggest that investors are better off actively trading the index inclusion effect on STOXX than on S&P. On the other hand, it is important to emphasize that the overall sample size used in our analysis is limited and that the time interval from which the data is gathered would preferably have been larger. Despite this, our findings may, in conjunction with the scientific literature published on the subject, serve as an indication that traders can capitalize on the Index Inclusion Effect. Moreover, our findings suggest that the profit potential of the effect will vary between indices, with the STOXX long strategy proving to be the superior alternative.

8 Bibliography

Bennett, B., Stulz, R. M., & Wang, Z. (2020). *Does Joining the S&P 500 Index Hurt Firms?* (No. w27593). National Bureau of Economic Research.

Biau, D. J., Jolles, B. M., & Porcher, R. (2010). P value and the theory of hypothesis testing: an explanation for new researchers. *Clinical Orthopaedics and Related Research®*, *468*(3), 885-892.

Biktimirov, E. N., & Xu, Y. (2019). Asymmetric stock price and investor awareness reactions to changes in the Nasdaq 100 index. *Journal of Asset Management*, *20*(2), 134-145.

Bloomberg. (2020). *Bloomberg*. Retrieved from: https://www.bloomberg.com/markets/rates-bonds

Chen, H., Noronha, G., & Singal, V. (2004). The price response to S&P 500 index additions and deletions: Evidence of asymmetry and a new explanation. *The Journal of Finance*, *59*(4), 1901-1930. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6261.2004.00683.x

Elliott, W. B., Van Ness, B. F., Walker, M. D., & Warr, R. S. (2006). What drives the S&P 500 inclusion effect? An analytical survey. *Financial Management*, *35*(4), 31-48.

Gagnon, L., & Karolyi, G. A. (2009). Information, trading volume, and international stock return comovements: Evidence from cross-listed stocks. *Journal of Financial and Quantitative Analysis*, 953-986.

Hacibedel, B., & van Bommel, J. (2006, January). Do emerging market stocks benefit from index inclusion?. In *Money Macro and Finance (MMF) Research Group Conference*. Retrieved from: https://www.researchgate.net/publication/5178114_Do_emerging_markets_benefit_from_index_inclusion

Harris, L. (2003). *Trading & Exchanges market microstructure for practioneers*. New York: Oxford University Press.

Johnson, B. (2019, January 18). What is an Index? *Morningstar*. Retrieved from: https://www.morningstar.com/articles/908177/what-is-an-index

Kasch, M., & Sarkar, A. (2013). Is there an S&P 500 index effect? Retrieved from https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr484.pdf

Mackenzie, M., & Platt, E. (2020, November 24). Tesla's market value soars to $500bn ahead of S&P 500 debut. *Financial Times*. Retrieved from: https://www.ft.com/content/97c5c50c-b00d-4031-bd15-1c5767c24242

Kim, T. K., & Park, J. H. (2019). More about the basic assumptions of t-test: normality and sample size. *Korean journal of anesthesiology*, *72*(4), 331–335. https://doi.org/10.4097/kja.d.18.00292

S&P Dow Jones Indices. (2020). S&P 500 Graph View. *S&P Global*. Retrieved from: https://www.spglobal.com/spdji/en/indices/equity/sp-500/#overview

S&P Global. (2020). Documents/spglobal. Retrieved from S&P Global: https://www.spglobal.com/spdji/en/documents/additional-material/sp-500-brochure.pdf

Shleifer, A. (1986). Do demand curves for stocks slope down? *The Journal of Finance*, *41*(3), 579-590.

Siegle, D. (2020). T Test. Retrieved from University of Connecticut: https://researchbasics.education.uconn.edu/t-test/#

STOXX. (2020, 12 12). Qontigo.com. Retrieved from: https://www.stoxx.com/index-details?symbol=SXXP

Vanguard. (2020, December). Index funds vs. actively managed funds. *Vanguard.com*. Retrieved from: https://investor.vanguard.com/index-funds/index-vs-active

Yahoo Finance. (2020). Yahoo Finance. Retrieved from: https://finance.yahoo.com/quote/T?p=T&.tsrc=fin-srch