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Does the market reward exceptional environmental performance?

An event study of the WilderHill New Energy Global Innovation Index

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Working with the thesis, we have combined renowned economic theory with more recent findings on the financial effects of sustainability and environmental friendliness. Applying established theory to study an increasingly important topic has been a rewarding experience that will be valuable when entering the working world.

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Abstract

This thesis studies if the market rewards exceptional environmental performance. To do this, we examine whether inclusion in the WilderHill New Energy Global Innovation Index (NEX) yields positive abnormal returns and abnormal trading volume around the announcement and the rebalance date of the new index constituents by applying the event study methodology. The sample consists of quarterly events starting from the index's inception in 2006 until today. Besides studying the effect on an aggregate level, the data is subcategorized into periods and regions to capture changes in investors' perceptions and regional differences, respectively.

This study does not find significant positive abnormal returns around the announcement date of the new index members or the effective rebalance date of the index. However, we observe regional differences, with the US showing significant positive abnormal returns for the period 2006-2013, while Asia and the Pacific are yielding significant negative returns for the period 2006-2013 and 2013-2019. Furthermore, this study finds a significant negative effect in the event window prior to the announcement for the period 2013-2019. This is in contrast to our initial hypothesis, which states that inclusion in the NEX Index should yield significant positive abnormal returns. On the other hand, we find significant positive abnormal trading volume around the rebalance date. This is in line with our hypothesis, which states that inclusion in the NEX index should have a significant positive effect on abnormal trading volume around the rebalance date.

Our thesis does not give any clear evidence on the expected positive link between environmental acclaim and financial performance. The results suggest that companies receive more attention around inclusion, but the price reactions are ambiguous. Asian investors seems to be penalizing inclusion, which corroborates the findings and sustainability redundancy hypothesis of Cheung and Roca (2013). This could also explain the overall price reactions, as negative reactions from investors with a sustainability redundancy view might cancel out the positive effects from other investor segments.

Keywords – Sustainable Finance, ESG, WilderHill New Energy Global Innovation Index

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1 Introduction

This study examines whether inclusion in the WilderHill New Energy Global Innovation Index (NEX Index) yields abnormal returns or abnormal trading volume around the announcement of the new index constituents and the effective rebalance date of the index. In a broader sense, inclusion in the index serves as a proxy for exceptional environmental performance. Thus, this study analyzes if the market rewards clean energy initiatives.

The efficient market hypothesis states that the stock price of a company reflects all available information. As such, one can analyze the effect of a particular event by quantifying the impact on the firm's stock price and trading volume. This thesis applies the event study methodology to test whether inclusion in the NEX Index yields abnormal returns and abnormal trading volume.

This study does not find a significant positive relationship between inclusion in the NEX Index and positive abnormal returns at an aggregate level. Interestingly, geographical sub-samples reveals that there is a change in the reaction over time for American stocks, from a significant positive effect to no significant effect. On the other hand, securities stemming from Asia and the Pacific appear to be penalized as there is a significant negative effect. A possible explanation for the adverse results is the sustainability redundancy hypothesis of Cheung and Roca (2013), which states that sustainability is viewed as a cost and a redundant constraint on portfolio optimization. Therefore, inclusion might be perceived as a negative signal by investors. These effects might cancel out other positive effects from inclusion, which could lead to negative or insignificant results. On the other hand, this study finds a significant increase in trading volume around the effective date, which is in line with the hypothesis behind this study.

The structure of the thesis is as follows: first, the thesis introduces the clean energy space before it presents the NEX Index and the index' eligibility criteria. The next section presents previous studies on the topic and how this paper contributes to the existing literature. Following the literature review, the theoretical framework presents the theories that explain the rationale behind the hypotheses. The literature helps to frame theories and extend existing knowledge within the topic, while the theoretical framework is the structure that shapes the hypotheses behind this study. Next, hypotheses are formulated and presented. The data section describes the sampling and cleaning process behind this study and the rationale behind the decisions. The succeeding section, methodology, describes the methodological approach, allowing the reader to assess the validity and reliability of the study. Next, empirical findings are presented and discussed in light of the hypotheses. The last section presents conclusions, limitations and suggestions for further research.

2 The NEX index

2.1 The clean energy space

With the increased focus on global climate change, a transition from conventional energy sources to renewables seems inevitable. According to the United Nations (2019), neither the Paris Agreement nor the 2030 Agenda for Sustainable Development can make the necessary impact on climate unless renewable energy sources replace the fossil fuel generation.

Consequently, policy measures such as subsidies for renewable energy generation are being introduced in large parts of the world, to increase the attractiveness of investments in the sector. In addition, technology improvements are happening at a rapid pace. According to the investment bank Lazard (2019), the average cost of generation (levelized cost of energy) from onshore wind and utility-scale solar plants has dropped about 70 and 90 % in the last ten years, respectively. In several parts of the world, the cost of new renewable generation is below or equal to the existing conventional sources like natural gas, coal, and nuclear.

As a result, capital is increasingly allocated towards solutions to climate change, with global investment in renewable energy capacity being $272.9 billion in 2018, far exceeding investments in new fossil fuel generating projects (United Nations, 2019). The investment alternatives for environmentally-focused investments, so-called "eco-investing", are several, with "green" stocks and environmentally focused mutual funds being popular alternatives among investors.

The increased attention has contributed to greater interest in the link between environmental and financial performance, but it remains unclear whether the relationship is positive or negative (Sokolovska & Kešeljević, 2019). Several studies explore if green investments can generate excess returns compared to "regular" investments and broad market indices. However, none has studied environmental index additions' effect on firm value. This study aims to contribute to existing research by examining whether inclusion in a clean energy index affects the share price and if investors could achieve a positive abnormal return by investing in stocks included in such an index. In other words: if the market reward stocks that are categorized as "best-in-class" at climate change initiatives.

2.2 About the index

The NEX Index is a global stock index that captures solutions to climate change with companies that focus on innovative technology, clean energy, low CO2 renewables, conservation, and efficiency. Rather than selecting components purely based on financial data, the NEX Index considers companies on technological, environmental, and relevance-to-sector criteria.

The clean energy sector has seen significant growth over recent years, with considerable growth stemming from outside the US. Therefore, the index has a global scope. It is composed of around 100 companies mainly from Europe, North-America and Asia with operations within wind, solar, biofuels, hydro, wave, tidal, geothermal and other renewable energy sectors to adequately reflect the emerging clean energy sector (WilderHill New Energy, 2020). Since its inception in 2006, the index has become one of the leading indexes for this theme and is frequently used as a benchmark for green mutual funds, e.g., DNB Miljøinvest (Morningstar, 2020). The index is also investable through an ETF, namely the Invesco Global Clean Energy ETF, with the symbol PBD.

Figure 2.1: NEX vs. S&P 500, EXXON and BP

The plot shows the return for the Invesco Global Clean Energy ETF vs. the S&P 500 ETF and the two oil majors EXXON and BP

2.3 Eligibility Criteria

A stock must have a meaningful exposure to clean energy to be eligible for inclusion. WilderHill defines "meaningful exposure" as at least 10 % of the market value coming from activities in clean energy. Stock selection is biased towards companies that derive more than 50 % of their market value from clean energy activities, subject to the judgment of the index provider. Furthermore, components must meet criteria related to liquidity and market capitalization. As the clean energy sector is still at an early stage in terms of the life cycle, the index is biased towards small-cap and mid-cap companies (WilderHill New Energy, 2020). Furthermore, the index rebalances quarterly and uses a modified equal-weighted calculation method, which implies that at the time of rebalancing, components are equally weighted.

As for exclusions, the index provider may remove components in the index if its members fail to meet the eligibility criteria, because of changing conditions in the industry or in the event of corporate actions, such as M&A activity, spin-offs and reorganizations. The index provider does not publish the reason behind the exclusion. Thus, it is not possible to know if the exclusion is based on a subjective assessment by the index provider or if the security removed fails to meet one of the quantitative criteria. In other words, it is unclear whether the removed stocks failed to meet the environmental performance standards of the index or not.

3 Literature review

3.1 ESG and financial performance

The relationship between ESG and corporate financial performance is empirically sound. In a meta-analysis, Friede, Busch, and Bassen (2015), review 2200 research papers on this relationship, in one of the most exhaustive studies done on the topic. The authors find that the business case for corporate ESG investments is solid, with roughly 90 percent of the reviewed studies showing a non-negative relation between ESG and financial performance.

Delmas, Nairn-Birch, and Lim (2015) investigate the relationship between greenhouse gas emissions and financial performance in accounting metrics from 2002-2008 using longitudinal data of 1095 US corporations. They found that during this period, reducing greenhouse gas emissions causes a decline in an indicator of short-term financial performance, given by return on assets. However, Tobin's Q increases, indicating that investors see the long-term value of improved environmental performance.

Ambec and Lanoie (2008) reviewed several empirical studies, and showed that improvements in the environmental performance of a firm are associated with gains in the economic or financial performance, because of potential revenue increases and cost cuts.

Despite increasingly available evidence on the performance of green or sustainable corporates, the situation is unclear when it comes to asset pricing. No consensus has yet been established about the performance of green financial assets. This study contributes to the literature by looking at the investor's reactions to environmental index membership.

3.2 Carbon emissions and firm risk

As this thesis looks at market reactions and low-carbon companies, the relationship between carbon emissions and the equity risk premium is important. Several studies find that there exists a negative green risk premium, a so-called "greenium" in the market (Bolton & Kacperczyk, 2020; Chava, 2014; Lucia, Ossola, & Panzica, 2019). The theory of a green risk premium proposes a link between a firm's carbon emissions and its cost of capital, where lowering carbon emissions should result in lower required return, as the carbon risk is lower. The proposed "greenium" is an independent risk factor that supplements the factors of established asset pricing models like CAPM or multi-factor models.

However, carbon risk could be accounted for in other ways, like fundamental re-evaluations of cash flows (Gorgen et al., 2019). Furthermore, green risk might also proxy for general political risk, as "clean" stocks are more likely to be awarded by political authorities in the future and "dirty" stocks are more likely to be punished (Hsu, Li, & Tsou, 2019).

Either way, recent literature indicates a relationship between carbon risk and a firms' required return. In our case, this advocates for a price increase around inclusion in the NEX Index if the event lowers the perceived carbon risk of the included company. However, this study does not find any indications of a lowered risk premium after a company is added to the NEX Index, evidenced by insignificant price reactions.

Lucia et al. (2019) find a negative and significant green risk premium for European stocks in the last years, looking at 1230 companies from the STOXX Europe Total Market Index. The authors constructed one green portfolio of firms that "met the highest level of energy efficiency and the lowest CO_2 emissions within the relevant sector", and one brown portfolio representing the worst scoring firms on efficiency and emissions. They find a significant negative greenium factor based on a long-short strategy involving the green and brown portfolios. The green factor is not highly correlated with any of the variables in the five-factor model of Fama and French (2015). In addition to finding a negative green risk-premium, the authors found a higher Sharpe ratio for the green portfolio, meaning that it creates a higher risk-adjusted return than the brown portfolio.

These findings are corroborated by Bolton and Kacperczyk (2020). They study a cross-section of 14400 listed companies in 77 countries over a period ranging from 2005 to 2018, basically the universe of all listed companies globally for which it is possible to obtain carbon emissions data. Their findings suggest that there is a carbon premium in all sectors in Asia, Europe and North America, when the greenium factor is represented by a firm's level of carbon emissions. Similar to Lucia et al. (2019), they find evidence suggesting that carbon risk is an independent factor, with low correlations between the greenium and known risk factors that predict returns.

Chava (2014) studies US firms in the period 1992-2007, and compares the implied cost of capital (given by analysts' earnings estimates) of stocks excluded by environmental screens and those without such environmental concerns. He finds that investors demand significantly higher expected returns on stocks excluded by environmental screens. Furthermore, the author provides evidence that the environmental profile of a firm is not simply a proxy for an omitted component of the overall riskiness of a company.

Hsu et al. (2019) use chemical emissions data from the US Environmental Protection Agency (EPA) and study US firms from 1992 to 2015. They find that highly polluting firms are more exposed to environmental regulation risk and therefore require higher average returns. In line with Bolton and Kacperczyk (2020), Lucia et al. (2019) and Chava (2014), they find that the difference cannot be explained by common risk factors alone.

On the contrary, Gorgen et al. (2019) do not find a greenium. They apply a methodology that resembles Lucia et al. (2019) for a global universe in the period 2010-2017, and find that the carbon risk premium is non-existent when studying it as an individual factor that affects the required return of a stock. However, they find that carbon emissions matter to investors, but that green and brown firm risk is better explained by unpriced fundamental re-evaluations of a company's cash flows than by changes in the required return.

This thesis hypothesizes that inclusion in the NEX Index will lower the risk premium of green firms, because inclusion in the index signals environmental leadership and results in a further decrease in perceived green risk. This should yield positive abnormal returns if investors view lower green risk as a consequence of NEX index membership. Thus, this study contributes to existing research on the pricing of green risk by checking if the perceived riskiness of the most climate-friendly firms decreases due to inclusion in an environmental index.

3.3 ESG index membership and firm value

In parallel with the growing interest in sustainable investments, ESG indices have received increased attention (van Stekelenburg, Georgakopoulos, Sotiropoulou, Vasileiou, & Vlachos, 2015). In turn, there have been conducted several studies on so-called index effects of ESG indices, with the aim of exploring investors' reactions to stocks going in and out of these indices. Index effects are positive or negative abnormal returns (and trading volumes) seen before, around or after a stock has been included in or excluded from a stock index.

An ESG index is typically a stock index that is composed of firms that perform exceptionally well when it comes to environmental, social, and governance (ESG) criteria. Such indices serve as institutional intermediaries in guiding investors who may find it difficult to gather knowledge independently about the ESG performance of firms. By adding or deleting stocks from their indices, the index providers send clear and strong signals to investors about whether firms have met the criteria established by these providers (Doh, Howton, Howton, and Siegel, 2010).

When it comes to ESG indices, literature shows substantial variation in both the sign and significance of the index effects, but several studies suggest an increased perceived value of ESG over time. The studies reviewed vary considerably in terms of sample region, time period, event window, indices and general methodology.

Curran and Moran (2007) look at inclusions and exclusions in the FTSE4GOOD UK Index for the period 1999-2002. Neither of the events has significant abnormal returns when studying the effects at the announcement and the effective change date separately. They do find an increasing trend towards inclusion and exclusion announcements having the expected effects on daily returns, but these movements are not significant either.

Becchetti, Ciciretti, and Hasan (2007) trace abnormal returns of US firms that enter and exit the Domini 400 Social Index between 1990 and 2004. The study finds significant negative abnormal returns around the announcement day for exclusions and no significant effects for inclusions. Interestingly, they find a significant upward trend in absolute value abnormal returns, irrespective of the type of event (exclusion or inclusion). This indicates increased importance of ESG activities, as the market increasingly award (punish) the included (excluded) companies over the period. They argue that the negative abnormal returns of excluded companies can be attributed to negative price pressure by ESG-focused mutual funds doing large transactions around the event, and not negative "shocks" from individual stockholders.

Chakarova and Karlsson (2008) uses a sample of French, German, British, American and Nordic companies added to the Dow Jones Sustainability World index (DJSI World) between 2002 and 2007. The authors study the announcement day, and find no abnormal returns for the full sample. However, when studying each year separately, they find that inclusions are penalized in the earlier years and exclusions are penalized in the later years. This indicates that the perceived value of ESG activities is increasing, in line with Becchetti et al. (2007). Furthermore, they find differences between countries: the market reacted negatively to the exclusions of Japanese companies and inclusions of American and British companies. Thus, they argue that the market reaction depends on the country or region.

Consolandi, Jaiswal-Dale, Poggiani, and Vercelli (2009) explores the reaction of European stock markets to index inclusion and exclusion announcements of the Dow Jones Sustainability STOXX Index (DJSSI) for the period 2002–2006. For inclusions, they observe positive abnormal returns that start before the announcement, and culminate around the effective date and then diminishes. For exclusions, the cumulated abnormal returns start to decrease shortly after the announcement, become negative shortly before the effective date and continue to decrease for the 10-day window after the exclusion. However, neither included nor excluded stocks experience abnormal returns on the respective event dates in isolation. Trading volumes of included companies increase before the announcement date (possibly due to anticipation effects) and after the date of the change. No volume effects are found for the excluded companies.

Doh et al. (2010) study the effects around of American stocks that are included or excluded in the Calvert Social Index from 2000-2005. They look at the announcement date. In line with the research of Becchetti et al. (2007) on the Domini 400 index, they find that the excluded firms have significant negative abnormal returns, while the effects on included firms are insignificant.

Cheung (2011) examines index effects the DJSI World, and looks at American firms included or excluded in the period 2002-2008. Unlike the aforementioned studies, they analyze the effects of index events on risk and liquidity in addition to returns. No significant effects are found around the announcement. However, the study finds a significant, temporary increase (decrease) in returns around the effective date for included (excluded) stocks, with larger effects of inclusion than exclusion. The study corroborates Becchetti et al. (2007) when it comes to American stocks, which are penalized when excluded from a sustainability index.

Robinson, Kleffner, and Bertels (2011) also study index effects of DJSI World, focusing on American companies entering and exiting the index from 2003-2007. The authors look at the announcement date and find no significant results, but they find a significant positive effect on returns in a 60-day window after inclusion. Furthermore, they find a temporary decrease in the value of firms for the first ten days after their removal from the DJSI. The difference in findings between Robinson et al. (2011), Chakarova and Karlsson (2008) and Cheung (2011) could come from differences in the estimation model, event windows or the slight difference in time periods studied.

Oberndorfer, Wagner, and Ziegler (2013) analyzes the effect of inclusion of German stocks in DJSI World and DJSI STOXX between 1999 and 2002. They find that inclusion in DJSI World has a significant negative effect on returns for both the announcement and the effective change date. In other words, the market penalizes inclusion. No inferences can be drawn for exclusions, which might be attributed to the small sample size of seven event firms in total.

Nakai, Yamaguchi, and Takeuchi (2012) study a sample of Japanese firms added and deleted from the Morningstar Socially Responsible Investment Index (MS-SRI) from 2003 to 2010. Looking at only the announcement date, they found that inclusion yields significant positive abnormal returns, but exclusion has no significant effects. The results contrast the findings of Chakarova and Karlsson on Japanese firms in the DJSI World. However, this could be attributed to attributes of the different indices, event windows, or the slightly different time periods examined. Continuing, Nakai et al. (2012) finds that the effects of inclusion over the period transitions from negative to positive. This finding is in line with other studies that find increasingly positive valuation of a company's membership in ESG indices (Becchetti et al., 2007; Chakarova & Karlsson, 2008; Curran & Moran, 2007).

Cheung and Roca (2013) study the DJSI World, looking at stocks from the Asia Pacific region between 2002 and 2010. In addition to examining abnormal returns, the authors study the effects on risk and liquidity (trading volume). They find that both index addition and index deletion results in a significant decline in returns, an increase in trading volume, no change in systematic risk, and an increase in firm-specific risk. The effects were the same for both the announcement and the effective date. This indicates that ESG matters to the Asia Pacific markets, but in a negative way. The findings are partly consistent with the "sustainability redundancy hypothesis" that the authors introduce. The hypothesis proposes that stock picking based on corporate sustainability is equivalent to imposing additional constraints on portfolio optimization, other than risk minimization and return maximization, resulting in sub-optimal portfolios.

Van Stekelenburg et al. (2015) study European companies in the period 2009-2013 and bases the study on DJSI STOXX. In addition to studying the effects of index changes, they study stocks that were acknowledged as "industry group leaders" in CSP (ESG) by the DJSI Europe over the same period. They observed no reactions on stock prices around announcement, but found a weak positive (negative) temporary effect from inclusion (exclusion) at the effective date and the succeeding period. Interestingly, they found a weak positive effect of a firm being recognized as "industry group leader" in CSP. The results suggest that European markets award sustainability, in contrast to the study Oberndorfer et al. did on German stocks in DJSI Stoxx in an earlier period (1999-2002). This is possibly due to an increasing valuation of sustainability by investors.

More recently, Hawn, Chatterji, and Mitchell (2018) do a large-scale longitudinal study on DJSI World. The authors study investor reactions to stocks from 27 countries over the period 1999-2015 that are added, deleted, or continue on the index, with emphasis on the index announcement date. One of the aims of Hawn et al. is to cope with "substantial empirical limitations" in previous studies on ESG indices. To do this, the authors study continuations as well as additions and deletions, include comparison groups of similar firms that were not added, look at both longer and shorter time frames, study multiple countries and control for firm-specific heterogeneity. They find that investors' valuation of sustainability globally has evolved over time, with diminishing reactions to US firms and increasing benefits, particularly of continuation on the index, over time. They find that when comparing results with observationally equivalent firms and adjusting for firm-specific factors, the addition, continuation, or deletion in the DJSI World has little impact on stock market returns.

The results of Hawn et al. (2018) are confirmed by Durand, Paugam, and Stolowy (2019), which replicate the previous study. In addition, Durand et al. study abnormal trading volumes, controlled for firm-specific factors and compared with similar firms, and find no significant effects. Furthermore, they extend Hawn et al. by looking at visibility. The authors find moderate evidence of increasing attention over time by financial analysts and long-term investors to inclusions and continuations.

Summing up, the effect of index changes seems to vary with region, index, time period and methodology, and several of the studies contradict each other. However, several of the index studies (Becchetti et al., 2007; Chakarova & Karlsson, 2008; Curran & Moran, 2007; Durand et al., 2019; Hawn et al., 2018) find indications of a positive sustainability trend over time, with investors increasingly valuing activities within ESG.

As the environment is a central part of ESG and companies' sustainability practices, studies of ESG indices should give good indications of investor reactions to inclusion in an environmental index. However, the nature of environmental indices such as NEX is different from the aforementioned ESG indices in the sense of what they measure. NEX and the majority of environmental equity indices (FTSE Environmental Opportunities 100 Index, FTSE Environmental Opportunities 100 Index, MSCI Global Climate Select Index and MSCI Global Environment Index) focus on firms where environmental and climate change solutions is a substantial part of the firms' core business. Thus, these indices arguably measure how well the included stocks perform their core business activities. On the other hand, the aforementioned ESG indices view ESG as CSR activities a firm does in addition to its core business. The firms included do not necessarily solve sustainability problems, but they are good at limiting the negative externalities of their businesses. For instance, Equinor is included in the DJSI World due to their exceptional performance within CSR, and not because they of their oil extraction.

Therefore, we argue that inclusion in an ESG index and inclusion in an environmental index is slightly different events, and that investor reactions might differ. The authors of this thesis do not find any other event studies studying index effects of stocks entering or exiting an environmental index. Thus, one of the main contributions of this study is being the first to apply event study methods to a purely environmental index.

Table 3.1: Summary of event studies done on ESG indices

Correlation between ESG index membership and stock price				
Study	**Index and time period**	**Region**	**Corr.**	**Summary**
Curran and Moran (2007)	FTSE4GOOD UK 1999-2002	UK	0	No significant effects on announcement (AD) or effective date (ED). Insignificant indications of ESG being valued higher over the period.
Becchetti et al. (2007)	Domini 400 Social Index 1990-2004	US	+/0	Negative effect of exclusion at AD. No effect of inclusion. Increasing value of ESG over time.
Chakarova and Karlsson (2008)	DJSI World 2002-2007	EU/US /Asia	+/0/-	No effects at AD for the full sample. Significant negative effects of Japanese exclusions, American inclusions and British inclusions. Increasing value of ESG over time.
Consolandi et al. (2009)	DJSI STOXX 2002-2006	EU	+	No effects on AD or ED for returns and volume. Significant positive (negative) abnormal returns for inclusions (exclusions) for longer event windows. Significant positive volume effects before AD.
Doh et al. (2010)	Calvert Social Index 2002-2005	US	+/0	Negative abnormal returns for exclusions at AD. No effects for inclusions.
Cheung (2011)	DJSI World 2002-2008	US	+	No significant effects at AD. Temporary increase (decrease) in returns around ED for inclusions (exclusions). Larger for inclusions.
Robinson et al. (2011)	DJSI World 2003-2007	US	+	Inclusion has a positive effect in the long term after ED. Excluded companies experience a temporary decrease in returns after ED.
Oberndorfer et al. (2011)	DJSI World/STOXX 1999-2002	Germany	-/0	Inclusion in DJSI World results in negative abnormal returns both on AD and ED. No effects for STOXX and exclusions in general.
Nakai et al. (2012)	MS-SRI 2003-2010	Japan	+/0	Inclusions results in significant positive abnormal returns on AD for the full sample. No effects for exclusion. Increasing value of ESG over time.
Cheung and Roca (2013)	DJSI World 2002-2010	Asia/ Pacific	-	Inclusion and exclusions result in significant negative abnormal returns, a positive abnormal trading volume and increased idosyncratic risk on both AD and ED.
van Stekelenburg et al. (2015)	DJSI STOXX 2009-2013	EU	+	Weak positive (negative) effect of inclusion (exclusion) around ED. No effects on AD.
Hawn et al. (2018)	DJSI World 1999-2015	Global	0	Inclusion, deletion and exclusion have a limited impact around AD when adjusting for relevant factors.
Durand et al. (2019)	DJSI World 1999-2015	Global	0	Replicate Hawn et al. with some extensions. Additionally, they find some evidence of ESG receiving increased attention over time.

3.4 Environmental events and firm value

Although there is a scarcity of event studies on environmental indices, several studies examine the impacts of other environmental events. Previous research has covered a large variety of events, such as environmental disasters, firm-specific scandals, regulations, certifications and ratings. This section presents the most relevant literature. The emphasis is put on environmental awards, certifications and recognition from third parties, as these events arguably are the most comparable to inclusion in an environmental index. The effects vary a lot in terms of size, sign and significance.

Klassen and McLaughlin 1996 examine the relationship between environmental management and the financial performance of a firm. Strong environmental management was indicated by environmental awards given by a third-party, the opposite was represented by firm-specific environmental crisis. Studying a sample of publicly listed firms on NYSE and AMEX, the authors find significant positive returns for the former and significant negative returns for the latter. They also discover that the market reacts more positively for first-time awards received by firms operating in "clean" industries compared to "dirtier" companies.

Flammer (2012) carries out an event study around the announcement of corporate environmental news for all publicly listed US companies from 1980 to 2009. She finds that the market reacts positively to the announcement of environmentally friendly initiatives, and negatively to the announcement of environmentally harmful behavior. Furthermore, she shows that, over time, the positive reaction to the announcement of eco-friendly initiatives has significantly decreased, while the negative reaction to the announcement of eco-harmful behavior has significantly increased. Companies with a larger stock of environmental resources experience less benefit from good initiatives but are also penalized less in the case of an eco-harmful event. This contrasts Klassen and McLaughlin (1996).

Jacobs, Singhal, and Subramanian (2010) build upon the work of Klassen and McLaughlin, and measure the stock market reactions from announcements of environmental performance between 2004 and 2006. They study two categories of announcements. The first category includes 430 announcements of Corporate Environmental Initiatives (CEIs), which are self-reported corporate efforts to reduce the environmental impacts of business activities. The second category consists of 381 announcements of Environmental Awards and Certifications (EACs), recognitions granted by third parties. The market does not react significantly to the aggregated announcements, but the authors find significant reactions for certain CEI and EAC subcategories. Announcements of philanthropic gifts for environmental causes lead to a significant positive market reaction, voluntary emissions reductions are associated with significant negative abnormal returns, and ISO 14001 certifications receive significant positive feedback by the market. ISO 14001 is the most recognized international standard for environmental management systems, and certifications are done by an independent third party (DNV GL, n.d.).

Noh (2019) studies the effect of ISO 14001 certification on 174 US firms listed on NYSE and NASDAQ during the 1996-2010 period. He finds that ROI and Tobins's Q shows an instant positive response after firms apply for the certification, implying that investors accept the announcement of ISO 14001 as a positive signal. There are also positive abnormal performances for asset turnover in both the short and long term. However, several other event studies find negative or weak effects of the ISO 14001 (Aarts and Vos, 2001; Cañón-de Francia and Ayerbe, 2009; Riaz, Saeed, Baloch, Nasrullah, and Khan, 2019), and the effects seem to depend on the geographical market and time period studied.

Evidently, the literature is inconclusive when it comes to the relevant environmental events, and stock prices reactions to the events cannot be generalized. The effects seem to depend on the type of event, sample and the time period studied. Therefore, past studies of relevant events provide ambiguity when forming expectations and hypotheses in this study. This study contributes to the existing body of knowledge by studying the effects of a relatively under-examined environmental event.

4 Theoretical framework

4.1 The efficient market hypothesis

The efficient market hypothesis (EMH) is a theory stating that the price of a share reflects all available information in the market (Fama, 1970). The efficient market is defined as a market where all participants are maximizing profits, and relevant information is available to everyone. The competition between market participants leads to a scenario where actual prices of individual securities already reflect the effects of information about past events and events that the market expects will happen in the future (Szylar, 2013). Therefore, there is no point in trying to beat the market by picking under- or overvalued stocks, as the observed prices will always be correct. The efficient market hypothesis relies on three assumptions:

1. There are no transaction costs: the market is liquid.
2. All available information is free for all market participants.
3. Market participants are rational and interpret information in the same way.

Going back to the hypothesis, Fama (1970) define three different forms of market efficiency: weak, semi-strong and strong-form efficiency. In its weakest form, market efficiency implies that the share price reflects all historical price and volume information. Thus, technical analysis does not yield excess returns, as all market participants have the same information on how technical signals relate to past movements. Semi-strong form efficiency means that all public information, including historical data, is reflected in the share price. Consequently, fundamental analysis is pointless, and the only way to beat the market is by having inside information. Strong-form efficiency includes inside information, meaning that there are no possible ways to beat the market. This thesis relies on the assumption that the announcement of new NEX index constituents is new information to the market. Thus, if investors value inclusion and the market is semi-strong, the effect on the share price should be accurately reflected in the share price within a short period of time.

The assumptions and propositions of the EMH do not hold entirely for most stock markets today. Fama (1970) argues that the assumptions are sufficient, but not necessary for a market to be efficient. Nevertheless, the hypothesis has some theoretical weaknesses. One critique against the theory comes from Grossman and Stiglitz (1980), and the "efficiency paradox." They argue that the market cannot be efficient, as information is costly. If prices reflect all available information, investors are not compensated for obtaining information, and therefore they have no incentives to look for it. Consequently, the market will not be efficient unless some market participants believe that it is not. Furthermore, Nobel laureate Robert Shiller has been a notable critic of the efficient market hypothesis. He believes that markets are not efficient and that human errors and biases tend to influence markets, leading to mispricing (Akerlof and Shiller, 2010; Shiller 2015). However, academia and business value both Fama and Shiller's perspective, and the EMH remains a default position for research, in the absence of strong evidence to the opposite beliefs.

4.2 Asymmetric information

According to Stiglitz (2002), asymmetric information is a problem that occurs when individuals have different levels of knowledge; for instance, the seller and the buyer in an economic transaction. When this is the case, one of the parties could have made better decisions if it had the same knowledge as its counter-party, which leads to inefficient outcomes. Almost all economic transactions involve information asymmetries. Because of this, a large industry of financial intermediaries such as investment banks, securities analysts, credit rating agencies, and financial advisors has emerged, partly on the assumption of dealing with the negative effects of information asymmetry (Fama, 1991; Leland and Pyle, 1977).

Harrison and Freeman (1999) argue that an investors' ability to absorb, process and interpret information is limited. Thus, it is logical to assume that companies know more about their environmental performance than stakeholders do. If one believes that investors value environmental performance, information asymmetries exist between a company and its (potential) investors (Connelly, Certo, Ireland, and Reutzel, 2011).

Relatedly, Doh et al. (2010), argue that asymmetric information provides a possible explanation as to why addition in an ESG index could result in an increase in firm value, as the asymmetry is reduced by inclusion. Inclusion in such an index is a way to reduce information asymmetries, by having a neutral third-party, the index provider that vouches for a firms' exceptional qualities within the field (Dorfleitner, Halbritter, and Nguyen, 2015).

Thus, ESG index providers, as a financial intermediary, can help to reduce the information asymmetry around the ESG activities of a firm. By including or excluding a stock, they provide valuable information on the firm's performance within ESG. Consequently, professional investors increasingly rely on these indices when investing, as these indices are perceived as "objective, professional benchmarks assessed by neutral parties" (Robinson et al., 2011).

4.2.1 Signaling theory

Closely connected to the problem of asymmetric information is the signaling theory, a theory that describes behavior in the presence of information asymmetries. According to Spence (2002), an important motivation with signaling theory is to reduce information asymmetry between two parties. The theory emphasizes "actions insiders take to intentionally communicate positive, imperceptible qualities of the insider", so-called signals (Connelly et al., 2011).

In their review of signaling theory, Connelly et al. (2011) define the signaller as an insider who possesses positive or negative information that is not available, and possibly useful for outsiders. Continuing, Connelly et al. (2011) defines the receiver, which refers to outsiders who lack information and wish to obtain it. A key point to signaling theory is that receivers, investors in our case, stand to benefit directly or in a shared manner with the signaller from making decisions based on information obtained from signals.

In this sense, information regarding environmental performance is among the signals a company sends to existing and potential investors. The addition of a company to the NEX index can be viewed as a signal to the market that it has reached a certain level of environmental performance. An environmental award itself, analogous to inclusion in an index, has little financial value to the firm, but it signals strong environmental standards, and the likelihood of continued strong performance and higher future earnings (Klassen and McLaughlin, 1996). Recently, Haninun, Lindrianasari, and Denziana (2018) find that disclosure of environmental performance has a significant positive effect on financial performance. If a sufficient amount of investors view inclusion in the NEX as a positive signal, the price should increase when the information is absorbed in the market.

4.3 Sustainability and the cost of capital

According to the dividend discount model, the price of a share is equal to future dividends, discounted back to the present value at the required rate of return. The previously presented studies on the greenium show that a firm's environmental externalities could impact its cost of equity. In addition, research shows that firms that are best-in-class when it comes to environmental management have significantly lower credit spreads, meaning that they achieve a lower cost of debt (Clark, Feiner, and Viehs, 2015). Therefore, sound environmental performance might decrease a firm's risk premium. Furthermore, researchers find that companies with excellent environmental practice also achieve a lower beta (Clark et al., 2015). Thus, if investors need to receive compensation for exposure to carbon risk (a negative greenium), inclusion in a green stock index like NEX could result in a decreased risk premium for a given stock, if the market views the company as more carbon-friendly due to inclusion. The hypothesized decrease in the greenium is strongly related to signaling theory, as the new market view of a firm's carbon risk is conditional on inclusion being a signal of lower carbon risk. In a semi-strong efficient market, the hypothetical decrease in risk premium should yield an immediate price increase at the inclusion announcement, as it lowers the required return.

4.4 Index effects

Another explanation for possible stock price or volume changes around inclusion in an environmental index is the so-called index effects. Previous evidence from several stock markets around the world has shown that stocks included in (excluded from) a stock index exhibit significant positive (negative) abnormal returns on the announcement date and the effective date, and that trading volume often increases because of the event (Bildik & Gülay, 2007).

There are several possible hypotheses that explain these effects. This thesis discusses five general hypotheses that could explain abnormal returns: price pressure, downward sloping demand curve, signaling, liquidity, awareness. These are the most commonly used hypotheses behind index effects. In addition, we present the ESG-specific sustainability redundancy and sustainability taste hypotheses of Cheung and Roca (2013). The first two hypotheses assume that the events of addition or deletion do not carry information itself, and that any effects come from excess demand from so-called non-information-based portfolio allocations like ETFs and index-tracking funds. The latter five hypotheses assume that the events carry information and affect the fundamental value of the securities through various channels.

The index effects hypotheses serve as important bases for the hypotheses presented in section 5, where price pressure and a downward sloping demand curve suggest a positive price and volume effects on the effective date. Signaling, liquidity, awareness and the sustainability taste hypothesis advocate positive effects when the information is absorbed in the market, which is likely to happen around the announcement if one assumes that the market is efficient. The sustainability redundancy hypothesis proposes an alternative hypothesis, and argues that inclusion is a negative signal, with negative effects when the information is absorbed by market actors.

Kraus and Stoll (1972) and Scholes (1972) propose the price pressure hypothesis, which assumes that prices increase around the change date of an index by excess demand of fund managers, and then reverse after the change date as passive sellers are attracted by the price increases that push the prices above equilibrium levels. Therefore, this theory predicts a temporary increase in the price and volume of a newly added stock close to the effective date. The opposite holds for exclusion. The price pressure hypothesis assumes that the index change announcement does not contain information itself, and that the effects come from price pressure from non-information-based allocations that track the index. Therefore, the price pressure hypothesis will only hold if a considerable amount of index-tracking investments follow the index, which makes it possibly more applicable to broad indices like the S&P 500. As the market capitalization of the NEX ETF is quite small, the validity of the hypothesis is probably conditional on the assumption that enough sustainable funds track the NEX index.

A related hypothesis is the downward sloping demand curve hypothesis proposed by Shleifer (1986). He hypothesizes that stocks have a downward-sloping demand curve, which advocates index effects like those of the price pressure hypothesis because of increased demand as an effect of ETFs and index funds buying (selling) included (excluded) stocks.

Similarly, the proposed effects should happen on the effective date. Unlike the price pressure hypothesis, the downward sloping demand curve hypothesis proposes that effects on price and volume are permanent from the effective date on, as the change in demand moves the demand curve and equilibrium price permanently.

A perhaps more relevant explanation to index effects is the signaling hypothesis (Denis, McConnell, Ovtchinnikov, and Yu 2003; Dhillon and Johnson, 1991; Jain, 1987). Based on the findings from signaling theory, the hypothesis applies the theory to index inclusions and exclusions. The signaling hypothesis proposes that such events are interpreted by investors as signals concerning the future value of the stock, because these events can reveal private information possessed by the index provider. If inclusion is a positive signal, the price should increase as soon as investors receive the news of index inclusion. Signals are also the drivers of the proposed decrease in the green risk premium discussed earlier, as index inclusion needs to be a signal of lowered carbon risk for the greenium to decrease by it.

Another related hypothesis is the liquidity hypothesis by Amihud and Mendelson (1986), which proposes that index inclusion increases the public information available and thereby reduces information asymmetries, which leads to increased trading volume and lower bid-ask spreads. Consequently, the stocks are suddenly less expensive for investors to trade, as transaction costs are lower. This results in a change in investors' liquidity risk perception, which is followed by a lower discount rate. Thus, the price and trading volume should increase around announcement or inclusion, depending on when the information is absorbed in the market.

Goetzmann and Garry (1986) proposes the awareness hypothesis. This hypothesis is related to signaling theory described in the preceding sections and the findings of Merton (1987), which shows that the rate of return depends on the degree of investor recognition and awareness. According to the awareness hypothesis, index stocks receive much more attention by investors than comparable non-index stocks. Thus, searching costs are reduced when a stock is included, which lowers trading costs and increases perceived value. The decreased trading costs should lead to a price and volume increase around the announcement and/or effective date, depending on when investors receive the information.

4.4.1 Sustainability index effects

In addition to the general index effects, Cheung and Roca (2013) propose two unique hypotheses for ESG indices: the sustainability redundancy hypothesis and the sustainability taste hypothesis. Both of the hypotheses assume that the event of inclusion carries information, meaning that the proposed effects should happen when the information is absorbed by investors.

The sustainability taste hypothesis suggests that investors may choose to invest in sustainable firms for other reasons than pure profit. Whether it be religion, morality, political views, loyalty, or other motivations, investors with tastes for sustainable firms can theoretically derive additional utility from the shares of sustainable firms, on top of the utility that they already get from the returns and dividends of these shares. Therefore, inclusion is a positive signal to such investors, and the price should increase if this segment is sizeable.

The opposing sustainability redundancy hypothesis is based on the assumption that companies that engage in corporate sustainability activities may earn lower returns because several of these measures are costly and do not maximize the utility of shareholders – only those of stakeholders and agents. An example of such an activity is investments in environmental measures beyond what is expected from investors. Investment decisions based on corporate sustainability is, therefore, equivalent to imposing an additional and unnecessary constraint on portfolio optimization, other than risk minimization and return maximization. This results in sub-optimal portfolios, and inclusion is therefore perceived as a negative signal by investors. Thus, the sustainability redundancy hypothesis proposes negative abnormal returns following inclusion in an ESG-related index, in contrast to all the other hypotheses in this subsection.

5 Hypotheses

Based on theory from the preceding sections, this study expects positive abnormal returns and volumes around the announcement and/or effective date if investors value inclusion in the NEX Index. As deletion from the NEX Index could be a result of corporate events like M&A, bankruptcies and reorganizations, and not necessarily unfavorable environmental performance, exclusions will not be studied. This results in the following hypotheses:

Hypothesis 1A: *Inclusion in the NEX index has a significant positive effect on abnormal returns around the inclusion announcement.*

Hypothesis 1B: *Inclusion in the NEX index has a significant positive effect on abnormal returns around the effective date.*

Hypothesis 2A: *Inclusion in the NEX index has a significant positive effect on abnormal trading volume around the inclusion announcement.*

Hypothesis 2B: *Inclusion in the NEX index has a significant positive effect on abnormal trading volume around the effective date.*

Findings from the literature review and the theoretical framework advocate that **1A** and **2A** are the ones most likely to hold. The index provider announces the changes in the index composition 10 (4) days prior to the effective date. In line with the efficient market hypothesis, the effects of the inclusion should be priced in immediately when the market becomes aware of it. Intuitively, this is most likely to happen when the information is made public, which is on the day of the announcement. Thus, if investors value inclusion in the NEX index, several theories propose positive effects on returns and trading volume on the announcement day:

First, a price increase is in line with the theory of a green risk premium, as an inclusion in the index could decrease the perceived carbon risk, and thus lower the required return, which again would increase prices as soon as the markets are aware of the event.

Second, signaling theory could explain a price increase at the announcement, conditional on the assumption that inclusion is perceived as a positive environmental signal and that investors value environmental performance.

Third, the liquidity hypothesis advocates for an increase in price and volume, because increased liquidity decrease the discount rate. Intuitively, this would be around the announcement day, as this is when the information is disclosed to the public.

Fourth, the awareness hypothesis could explain an increase in price and volume around the announcement or the change date, as the trading costs are immediately decreased if investors believe that inclusion in the NEX index will increase attention and reduce searching costs for the included stocks.

Fifth, the more recent sustainability taste hypothesis for ESG indices by Cheung and Roca (2013) proposes a positive effect on returns and volume at the announcement. Because investors with tastes for sustainable firms can theoretically derive additional utility from the shares of sustainable firms, the inclusion in a sustainable index can increase the demand for the included stock from such investors.

When it comes to Hypothesis **1B** and **2B**, these are mainly based on the price pressure hypothesis and the hypothesis of a downward sloping demand curve for stocks, which explain index effects at the effective date. Contrary to all the aforementioned explanations, these two hypotheses are based on the assumption that inclusion in NEX carries no information itself.

According to the price pressure hypothesis, prices and liquidity of stocks included in the NEX index should increase around the effective date because of excess demand by index-tracking allocations like ETFs and index funds, and then reverse after the change date as passive sellers are attracted by the price increases that push the prices above equilibrium levels.

The downward-sloping demand curve hypothesis advocates similar effects of inclusion, namely positive abnormal returns and positive abnormal volume. However, the effects should be permanent, not temporary. This is because of the proposed downward sloping demand curve, and the change in demand from index-tracking allocations which moves the equilibrium price and volume permanently.

An alternative hypothesis is the sustainability redundancy hypothesis, which suggests negative price effects of inclusion in the NEX index, as investors view sustainability as a cost and an unnecessary constraint on portfolios.

It should be noted that all the possible explanations for effects on the announcement date could be applied to explain effects on the effective date, if one believes that the stock markets absorb the information at the effective date. However, this is intuitively less likely to be true, as the information is made public ten days before. In an efficient market, the inclusion in NEX should be priced in before the effective date if the event carries valuable information.

Because of the considerable variation in ESG index effects between regions (see Table 3.1), we isolate returns and trading volumes of European, North American and Asian stocks respectively, in addition to analyzing the full global sample. This gives us the additional Hypothesis 3, which seeks to explore any regional differences in the significance, size and sign of the effects:

Hypothesis 3: *The effects of inclusion in the NEX index differ between regions.*

Table 5.1: Summary of the theories and their relation to our hypotheses

Hypothesis and author(s)	**Rationale**	**Effects**
Price pressure Kraus and Stroll (1972); Scholes (1972)	Inclusion results in excess positive demand from ETFs and index funds, and then reverse after passive sellers are attracted by the price increases that push the prices above equilibrium.	Temporary increase in price and volume around ED. Supports Hypothesis 1B and 2B in section 5.
Downward sloping demand curve Shleifer (1986)	Stocks have a downward sloping demand curve, which is moved outwards due to inclusion. The shift comes from a change in demand from ETFs and index funds.	Same as the price pressure hypothesis, but permanent. Supports Hypothesis 1B and 2B.
Signaling Denis et al. (2003); Dhillon and Johnson (1991); Jain (1987)	Index inclusion is a positive signal, and might reveal information that has previously been private. Related to the theory of a "greenium", as the hypothetical decrease in the risk premium is a result of inclusion signalling lower carbon risk.	Increase in price when investors absorb the news. Supports Hypothesis 1A.
Liquidity Amihud and Mendelson (1986)	Inclusion results in more publicly available information on a stock which leads to higher liquidity and lowers the perceived liquidity risk.	Increase in price and trading volume when investors absorb the news. Supports Hypothesis 1A and 2A.
Awareness Goetzmann and Garry (1986)	Inclusion increases awareness. This results in more publicly available information, which lowers information search costs and increases the value of the stock.	Increase in price and trading volume when investors absorb the next. Supports Hypothesis 1A and 2A
Sustainability taste Cheung and Roca (2013)	ESG index inclusion signals increased sustainability. Investors who are positive towards sustainability can derive additional utility from holding sustainable stocks, apart from the profits.	Increase in price when investors absorb the news. Supports Hypothesis 1A.
Sustainability redundancy Cheung and Roca (2013)	Sustainability is costly, and imposes an unnecessary constraint on portfolio optimization. Therefore, inclusion is a negative signal to the market.	Decrease in price when investors absorb the news. Alternative hypothesis to 1A and 1B.

6 Data

This section describes the data collection and pre-processing steps for this study. First, we identify additions to the NEX index from Q2 2006 to Q1 2020. Historical additions to the NEX index are available through quarterly reports on the NEX index's official website. Daily closing prices, trading volumes, and index prices are all retrieved from Datastream. All stock prices are adjusted for dividends by acquiring a total return index. Returns are calculated as the logarithmic change in the total return index by the following formula:

$$r_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \tag{6.1}$$

Where $r_{i,t}$ is the return for stock i at time t, while $P_{i,t}$ and $P_{i,t-1}$ denote the value of the total return index for stock i at time t and $t-1$ respectively.

Next, the selection criteria for inclusion of a specific security in the sample is determined. Securities outside Asia-Pacific, Europe, and North America are removed from the sample due to the low sample size. Furthermore, securities with a shorter track record than 315 days from the event day are removed from the sample, because the lower bound of the estimation window is set to -315 days before the event date. This is described in more detail in section 7.3. Additionally, securities without daily trading volume are removed from the sample.

Multi-country event studies suffer from the lack of synchronism in stock market trading hours, which creates a challenge for event studies as the market reaction to new information will not happen simultaneously. Given the 5-6 hours difference between Europe and America, trading allows for overlapping, and the market can react to new information on the same day. However, there is a roughly 12 hour time difference between American and Asian countries. Hence, trading hours do not overlap (Park, 2004). Thus, investors are unable to react simultaneously to announcements. To deal with the lack of synchronism in trading hours, Asia and the Pacific are lagged by one day.

Another issue that occurs in multi-country event studies is country-specific events, such as national holidays or national crises, which could result in missing values. To deal with missing values, rows that contain missing values are removed from the sample, as only a few returns are missing. This technique is suggested by Brown and Warner (1985).

Table 6.1: Historical inclusions

Effective date	# Included stocks	# America n stocks	# European stocks	# Asia/Pacific stocks	Effective date	# Included stocks	# American stocks	# European stocks	# Asia/Pacific stocks
31.12.2019	3		3		28.09.2012	4		1	3
30.09.2019	1			1	29.06.2012	1		1	
29.03.2019	1	1			30.12.2011	5	2	1	2
31.12.2018	1			1	30.09.2011	1	1		
28.09.2018	1			1	30.06.2011	1		1	
29.06.2018	4	1	3		31.12.2010	5	2	1	2
30.03.2018	5		2	3	30.09.2010	1			1
29.12.2017	5	1	3	1	30.06.2010	2	1		1
29.09.2017	2		1	1	31.03.2010	3	3		
30.06.2017	1		1		31.12.2009	2		1	1
31.03.2017	2		1	1	30.09.2009	3	1		2
30.12.2016	3		1	2	30.06.2009	3	2	1	
30.09.2016	5	3	2		31.03.2009	1	1		
30.06.2016	1			1	31.12.2008	2	1		1
31.03.2016	2		1	1	30.09.2008	3	2	1	
31.12.2015	3			3	31.03.2008	2	1		1
30.09.2015	1			1	31.12.2007	1	1		
30.06.2015	1		1		28.09.2007	1			1
31.03.2015	3	1	1	1	29.06.2007	5		3	2
31.12.2014	1		1		30.03.2007	2	1	1	
31.03.2014	4	4			29.12.2006	3		3	
31.12.2013	7	4	3		30.06.2006	1			1
30.09.2013	1			1	31.03.3006	1		1	
28.06.2013	1			1	sum	112	34	40	38

Note: The table displays inclusions in the sample at the different event days for the respective regions.

Table 6.1 shows the final sample with event dates and the number of events for the respective regions. Out of 229 events, 112 made the sample with 34 securities stemming from North-America, 40 from Europe and 38 from the Asia-Pacific.

Finally, the data is cleaned for outliers. If outlier returns are present in the estimation data, the abnormal returns and ACAR statistics for the event windows will be biased, as their variances are inflated. As such, t-statistics will be smaller and could lead to wrongful conclusions (Theodossiou & Theodossiou, 2019).

The boxplot in figure A0.1 in the appendix shows the unprocessed data and contains outliers. To deal with the outliers present, the estimation data is winsorized at the 5th and 95th percentiles, meaning that extreme observations are replaced with less extreme values. Figure A0.2 shows the data after the sample is cleaned for outliers.

7 Event study methodology

This study employs the event study methodology to measure the effects of changes in the NEX index composition on stock returns and the trading volume for multiple countries. The event study method is widely used to measure the effect of a specific event on the value of a company (MacKinlay, 1997). However, most event studies have analyzed the impact in a single-country (Park, 2004). This study aims to contribute to the existing literature on how to deal with methodological challenges that emerge in an event study for multiple countries.

7.1 Event study framework

Based on MacKinlay (1997), the workflow of this event study could be summed up as:

1. Definition of the event window
2. Estimate normal returns/volume
   (a) Choice of the estimation model
   (b) Define the estimation window
3. Estimation of abnormal returns/volume
4. Statistical testing for the significance of the abnormal returns/volume

7.2 Event window

The NEX Index rebalances quarterly on the last trading day each March, June, September, and December. As for announcements, the components are determined and announced at the close of trading ten business days before the rebalance date. However, former NEX "index methodology" documents refer to the announcement day as the close of trading four days before the rebalance date. There is no information to obtain regarding when NEX changed the announcement date. Thus, both announcement dates are tested for effects, where four days before inclusion is referred to as AD1 and ten days before is referred to as AD2. This leaves us with two events for each addition to the index, namely:

- The announcement date (AD1/AD2).
- The rebalance/effective date (ED).

After identifying the events of interest, the length of the event windows needs to be determined. There is no "one size fits all" when it comes to the length of the event window. Usually, the event window is set to be larger than the event of interest, which allows for studying the days surrounding the event of interest. The event window often includes the day of interest and the day after. Periods prior to and after the event may also be of interest (MacKinlay, 1997). Typically, event windows such as [-2,2] and [-1,1] are used. This study aims to separate the effect of pre and post-event reactions. Thus, the days prior to and after the event are tested in separate event windows. As mentioned, one challenge that occurs in multi-country event studies is the lack of synchronism in trading hours. Furthermore, it is reasonable to assume that the market needs some time to react to the new information. Thus, a narrow event window such as [0,1] or [0,2] could potentially fail to pick up any index effects. Therefore, this study expands the event window from the standard ones, by including the event plus the two following days. The following event windows are tested:

Table 7.1: Event windows

Event window		**Measured effect**
Lower bound	Upper bound	
-15	30	Long-term
0	3	Event date
-5	-1	Pre-event

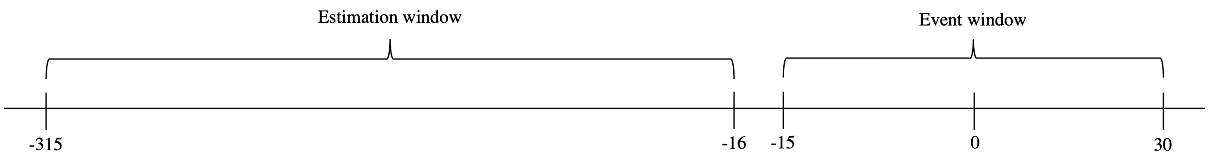
Note: The table shows the event windows tested in this study. Zero denotes the event date for both the AD and the ED.

The event window [0,3] aims to pick up abnormal returns around the AD and the ED. The design of this event window is based on the drivers for the hypotheses. Thus, if the release of new index constituents is new information to the market, investors or creditors value the inclusion, asymmetric information is reduced, or that index effects are present, positive abnormal returns are expected. The event window [-5,-1], referred to as the "pre-announcement" window, aims to pick up abnormal returns before the event date. However, as the stocks included in the index are based on a subjective review, it is unlikely that fund managers or analysts are able to identify added securities before the event day. Thus, abnormal price movements are not anticipated. Lastly, the window window [-15,30] is referred to as the “long-term” window and seeks to pick up the long-term effects. If investors value the drivers behind Hypothesis **1A** and **2A** but need time to analyze and react to this new information, positive abnormal returns are expected in the long term. Furthermore, this is expected from the downward sloping demand curve hypothesis, which is a basis for Hypothesis **1B** and **2B**.

7.3 Estimation window

In multi-country event studies, the estimation window is more likely to contain country-specific noise (Park, 2004). Due to the nature of the sample size, checking each stock for unusual market movements would be too time-consuming. As an alternative, this study applies a longer estimation window compared to the literature. An estimation window of 300 days prior to the lower bound of the event window is applied. An even longer estimation window would lower the sample size considerably and is therefore not used. The structure of the event and estimation window could be illustrated by the following figure:

Figure 7.1: Event study timeline



Note: The figure illustrates the structure of this event study. Zero denotes the event date.

7.4 Estimation of normal returns

Although several models are available for estimating normal returns, the simple market model (regressing returns on a market index) and multi-factor models are among the most commonly used in event studies (MacKinlay, 1997). When estimating normal returns in a multi-country event study, country-specific effects like currency exchange rates, economic growth, inflation and interest rates might significantly influence stock returns, which could favor of multi-factor models. However, it remains unclear whether these factors have a stable and significant impact on stock returns over time. Furthermore, global and domestic markets have almost the same importance in explaining equity returns (Ferson & Harvey, 1994). According to Ferson and Harvey (1994), it remains to see that these factors have a stable and significant impact on stock returns.

Ferson and Harvey (1994) proved that global and domestic stock markets had almost the same importance in explaining equity returns. With increasingly integrated financial markets, one could assume that this is still the case. However, Lundgren and Olsson (2010) compared different methodologies for event studies, and show that the findings of Ferson and Harvey (1994) do not hold. They find that the market model using a domestic index had significantly higher explanatory power than using a global index, but the differences between the simple domestic market model and a multi-factor model (supplementing the domestic index) were minor.

Thus, to settle on the model choice of this study, a sample of returns from different countries were regressed on domestic, regional, and an all-countries index, with only negligible differences in explanatory power between domestic and regional indices. Therefore, the simple market model with a regional small-cap index is used to estimate normal returns for this study. The market model can be written as:

$$E(r_{i,t}) = \alpha_i + \beta_i r_{m,t} + \epsilon_{i,t} \tag{7.1}$$

Where $r_{i,t}$ and $r_{m,t}$ represent the estimated return for stock i at time t and the market portfolio $r_{m,t}$ respectively. $\epsilon_{i,t}$ represent the error term, while α_i and β_i are parameters of the regression model. To control for geographical differences and size, regional small-cap indices are used as a proxy for the market return. The following three indices are used:

- USA: Russell 2000
- Europe: MSCI AC Europe Small cap Index
- Asia/Pacific: MSCI AC Asia Small Cap index (USD)

Russell 2000 consists of the 2000 companies with the lowest market cap in the Russell 3000 index, and aims to track the performance of American small-cap firms. The index is frequently used as a benchmark for US small-caps, and we found it to explain a considerable proportion of the returns for the Canadian sample firms as well. The MSCI Europe Small Cap Index captures European small-cap companies across 15 developed markets in Europe and is a well know benchmark for European small-cap. The MSCI Asia Small Cap Index captures Asian small-caps across three developed and nine emerging markets. The indices are weighted using free-float market capitalization.

7.5 Abnormal returns

Abnormal return is the difference between the observed return and the estimated normal return. Abnormal return for security i at time t is calculated as follows:

$$AR_{i,t} = r_{i,t} - E(r_{i,t}) \tag{7.2}$$

Abnormal returns are calculated over the whole event window [-15, 30] for each security, before abnormal returns are averaged out over N securities. This yields the average abnormal return AAR. AAR is calculated as follows:

$$AAR = \frac{1}{N} \sum AR_{i,t} \tag{7.3}$$

Finally, average cumulative abnormal returns are calculated (ACAR) to measure the abnormal effects over the different event windows. ACAR is calculated as follows:

$$ACAR = \sum_{t=f}^{t=1} AAR_t \tag{7.4}$$

Where f is the first day of the estimation window and l denotes the last day of the estimation window.

After the computation of ACAR, the next step is to test their statistical significance. The variance of AAR is calculated as follows:

$$\sigma^2_{AAR} = \frac{1}{N-2} \sum_{T=t_0}^{T_1} \left(AAR_t - \overline{AAR}\right)^2 \tag{7.5}$$

Where T_0 and T_1 represents the length of the estimation window.

To test if the $ACAR$ is statistically different from zero, H0: $ACAR = 0$, the following test statistic is computed:

$$t_{ACAR} = \frac{ACAR}{\sqrt{l - f}\sigma_{AAR}} \tag{7.6}$$

Where $l - f$ represents number of days in the event window.

7.6 Abnormal trading volume

Another contribution this study offers is if the stock included in the NEX index experience any abnormal trading. The trading volume metric is calculated as the percentage of outstanding shares traded on a given day. The trading volume metric could be calculated as follows:

$$V_{i,t} = \ln\left(\frac{n_{i,t}}{S_{i,t}} \cdot 100\right) \tag{7.7}$$

Where $n_{i,t}$ and $S_{i,t}$ denote the number of shares traded and number of shares outstanding for security i at time t. Previous studies show that RAW trading volume is highly non-normal. However, log-transformed data yields a normal distribution(Campbell & Wesley, 1993).

To estimate the expected trading volume, the study relies on a mean-adjusted trading volume model which could be written as follows:

$$AV_{i,t} = V_{i,t} - \overline{V_{i,t}} \tag{7.8}$$

where,

$$\overline{V_{i,t}} = \frac{1}{T}\sum_{T=t_0}^{T_1} V_{i,t} \tag{7.9}$$

T denotes the number of days in the estimation period. The length of the estimation window is the same for abnormal returns and volume, 300 days.

This study uses a parametric test to test if the abnormal trading volume is statistically different from zero. The test statistic could be calculated as follows:

$$t_{AV,t} = \frac{\overline{AV_t}}{\sigma AV} \tag{7.10}$$

Where,

$$\overline{AV_t} = \frac{1}{N} \sum AV_{i,t} \tag{7.11}$$

and,

$$\sigma AV = \sqrt{\frac{1}{T} \sum_{T=t_0}^{T_1} \left(AV_t - \overline{AV_t}\right)^2} \tag{7.12}$$

7.7 Cross-sectional analysis

To extend our analysis, we perform a cross-sectional analysis to test for interference between the sample companies' cumulative abnormal returns (CARs) and firm-specific characteristics. The dependent variable of the analysis is the individual CARs of each company in the full sample from window [0,3] around the rebalance date (ED). Two companies are removed from the original sample: one (Credit Suisses Real Estate Fund Green Property) because it is an exchange-traded fund, the other (Epistar) due to missing financials.

7.7.1 Factor selection

To account for firm-specific traits, we have chosen to control for firm size, market value versus book value, financial leverage and price to earnings. Thus, CAR is regressed on common ratios used for comparative financial valuations: market capitalization, price/book, price/earnings, and debt/total assets. We also include region dummies, to assess whether there are regional differences in CARs after adjusting for firm-specific traits. Europe is the baseline region.

Market capitalization: Market capitalization in USD at the time of inclusion, proxies for size. Firm size as a factor in explaining returns has a solid empirical background, and it is used in most empirical asset pricing models, i.e., the three-factor model (Fama & French, 1993), the four-factor model (Carhart, 1997), and the more recent five-factor model (Fama & French, 2015). These studies show that small firms tend to outperform large firms. The firm-size variable is bounded by zero and right-skewed. Therefore, researchers tend to log-transform it, which is also done here.

Price/Book (P/B): Market capitalization over book value of equity at the time of inclusion. All the asset pricing models mentioned above use this relationship, commonly expressed by the reverse ratio, Book/Market. Value stocks (with low P/B-ratios) tend to outperform growth stocks (with higher P/B-ratios), which academic research has persistently shown.

Price/Earnings (P/E): Current share price relative to the earnings rate per share. P/E ratios are used by investors and analysts to find the relative value of a company's shares in order to make reasonable comparisons. Similar to P/B, relatively low P/E values characterize value stocks, and high values describe growth stocks. Intuitively, negative P/E's are hard to interpret, as a company with marginally negative earnings could have strongly negative P/E-ratios. Therefore, negative P/E-ratios are set to zero.

Debt-ratio (D/A): Debt as a proportion of total assets. We use data from the latest published financials at inclusion. The higher the ratio, the more leveraged a company is, implying higher financial risk. Fama and French (1992) found a negative relationship between the book value of leverage and stock returns.

This gives us the following OLS regression, with Europe as the baseline region:

$$CAR_{i,t} = \alpha + \beta_1 \ln(Market - cap)_{i,t} + \beta_2 \frac{P}{B} i,t + \beta_3 \frac{P}{E} i,t + \beta_3 \frac{D}{A} i,t + D1_{ASIA} + D2_{US} \quad (7.13)$$

Where $D1_{ASIA}$ is a dummy variable that takes the value of one if the stock is from Asia or the Pacific, zero otherwise. $D2_{US}$ is a dummy variable that takes the value of one if the stock is from the US or Canada, zero otherwise.

8 Empirical findings and discussion

8.1 Abnormal returns

Table 8.1: Results: abnormal returns

Event	2006-2019	All regions		EU		US		ASIA	
	Event window	ACAR	T-stat	ACAR	T-stat	ACAR	T-stat	ACAR	T-stat
Long term	[-15,30]	-6,25%	2,47**	-1,39%	0,43	-6,66%	1,22	-10,52%	2,66***
ED	[0,3]	-0,82%	1,09	-0,42%	0,44	-0,24%	0,15	-1,68%	1,44
AD1	[0,3]	0,64%	0,85	0,24%	0,25	2,49%	1,55	-0,57%	0,49
Pre AD1	[-5,-1]	-0,95%	1,14	0,15%	0,14	-0,57%	0,32	-2,32%	1,78*
AD2	[0,3]	-0,30%	0,40	-0,28%	0,30	1,01%	0,63	-1,44%	1,24
Pre AD2	[-5,-1]	-0,39%	0,46	0,47%	0,44	-1,88%	1,05	0,07%	0,06
	2013-2019	All regions		EU		US		ASIA	
Long term	[-15,30]	-8,31%	2,55**	-8,83%	1,80*	-13,77%	1,64	-9,91%	2,27**
ED	[0,3]	-0,46%	0,47	-1,56%	1,08	1,14%	0,46	-1,17%	0,91
AD1	[0,3]	0,60%	0,62	1,31%	0,91	0,74%	0,30	-0,37%	0,29
Pre AD1	[-5,-1]	-1,82%	1,69*	-0,98%	0,61	-1,45%	0,52	-2,83%	1,96*
AD2	[0,3]	-0,63%	0,65	-0,61%	0,42	0,95%	0,38	-1,72%	1,33
Pre AD2	[-5,-1]	-0,48%	0,45	-0,39%	0,24	-2,69%	0,97	0,86%	0,60
	2006-2013	All regions		EU		US		ASIA	
Long term	[-15,30]	-3,96%	1,07	0,80%	0,21	-1,05%	0,14	-11,27%	1,67*
ED	[0,3]	-1,22%	1,11	0,14%	0,12	-1,33%	0,61	-2,31%	1,17
AD1	[0,3]	0,68%	0,62	-1,44%	1,25	3,88%	1,78*	-0,81%	0,41
Pre AD1	[-5,-1]	0,01%	0,01	1,80%	1,40	0,11%	0,05	-1,69%	0,76
AD2	[0,3]	0,06%	0,05	0,16%	0,14	1,07%	0,49	-1,10%	0,55
Pre AD2	[-5,-1]	-0,28%	0,22	1,56%	1,21	-1,23%	0,51	-0,89%	0,40

Note: The table display abnormal returns for the event windows tested in this study. ED denotes the effective date (the last trading day each March, June, September, and December), AD1 denote the announcement date at the close of trading four business days before the effective date, while AD2 represent the announcement date at the close of trading ten business days before the effective date.
$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

8.1.1 Short-term effects

Hypothesis **1A** and **1B** state that inclusion in the NEX index should yield abnormal returns around the announcement date or the effective rebalance date. Table 8.1 displays the results from this study. The results show no significant positive abnormal return around the announcement date nor the effective rebalance date for the period 2006-2019.

The results do, on the other hand, show a significant negative abnormal return of -1,82% for the event window, pre-announcement date 1 for the period 2013-2019 at the ten percent level, while the period 2006-2013 displays no significant results. In addition, there is a change in the long-term effects. By comparing 2006-2013 to 2013-2019, there is a shift from insignificant negative to significant negative, indicating an increasingly negative view of inclusion.

Geographical sub-samples shows a significant negative reaction at the ten percent level for securities from the Asia Pacific, for the event window, pre-announcement date 1, for the period 2006-2019 and 2013-2019. Thus, sustainability might be viewed as redundant by Asia Pacific markets. This corroborates the findings of Cheung and Roca 2013, where they find significant abnormal returns for Asia Pacific stocks that were included in the DJSI World between 2002 and 2010.

Furthermore, securities stemming from the US have a significant positive abnormal return of 3,88% at the ten percent level for the period 2006-2013, which indicates that there are some regional variations, as proposed in Hypothesis **3**, which states that the effect of inclusion in the NEX Index will differ between regions.

For the other event windows, ACAR is biased towards negative abnormal returns. However, these ACARs are insignificant apart from the previously described exceptions, making it difficult to draw any conclusions for the whole sample.

Based on these findings, there is no support for Hypothesis **1A** nor **1B**, which implies that inclusion in the NEX Index does not yield significant positive abnormal returns. Hypotheses **1A** and **1B** are both rejected.

Since Hypothesis **1A** and **1B** are both rejected, it is reasonable to review the assumptions behind the hypotheses. The following paragraphs of the section will discuss the theories and assumptions that are most likely to explain the results.

The theoretical framework is the structure that motivates the hypotheses behind this study. The following theories are identified as critical for the development of Hypothesis **1A** and **1B**;

- Semi-strong market efficiency
- Asymmetric information
- Signaling and the greenium
- Index effects

- The price pressure hypothesis
- The downward sloping demand curve
- The liquidity hypothesis
- The awareness hypothesis
- The sustainability taste hypothesis

This thesis relies on the assumption of Semi-strong market efficiency. An implication is that the announcement of new index members is new information to the market. Thus, if investors value inclusion, the effect on the share price should be accurately reflected within a short period of time. One explanation for the lack of significant positive abnormal returns is that the market has priced in the inclusion before the announcement. Consequently, the announcement would not be new information to the market. However, the securities included in the index are subject to qualitative assessments from the index provider, meaning that the market must be efficient in the strong-form (private information is also accounted for in a stock's price) to reevaluate new members of the NEX Index before the announcement.

Another major assumption behind this thesis is linked to the reduction in asymmetric information. Asymmetric information is a problem that occurs when individuals have different levels of knowledge (Stiglitz, 2002). When this is the case, one of the parties could have made better decisions if it had the same knowledge as their counterparty. Inclusion in a recognized index could help reduce the information asymmetries, by having a neutral third party that vouches for a firm's quality within a particular field. One reason for the differences between the findings of this research on an environmental index and some of the studies of other ESG indices might lie in the nature of the indices. More specifically, it could be attributed to whether the inclusion event reduces asymmetric information. ESG indices usually score companies on how they meet ESG issues across all three dimensions, but this does not need to be the companies core business. The NEX index, on the other hand, score companies based on their performance within their core business, namely solutions to climate change. One can argue that information about a company's core business is easier to obtain than its ESG score. Thus, inclusion in an ESG index may offer a higher reduction in asymmetric information than an addition to the NEX index. If this is the case, inclusion in the NEX index will not provide more information, as investors already are aware of the companies' position within the clean energy sector.

One fundamental assumption that motivates Hypothesis **1A** and **1B** is linked to the theory of a greenium, which proposes a link between a firm's carbon emissions and its cost of capital, where reduced carbon emissions should result in a lower required return. Our application of this theory is motivated by signaling theory. This study assumes that inclusion in the index viewed as a positive signal, because investors value clean energy initiatives and that inclusion reduces information asymmetries, which increases value. The possible decrease in the greenium would also come from signals, as inclusion needs to signal lower risk for the greenium to decrease by it. If a greenium exists and the market view inclusion as a positive signal, inclusion should reduce a firm's cost of capital and reduce information asymmetries, which should increase the share price, all else equal. This does not seem to be the case. A possible reason is that inclusion does not signal a further decrease in carbon risk. Carbon riskiness might already be priced in beforehand, and inclusion does not change the risk perception enough to move prices. A more general explanation is that the NEX inclusion itself is not a valuable signal to investors. Therefore, the signal of inclusion does not impact future cash flow estimates or required returns significantly.

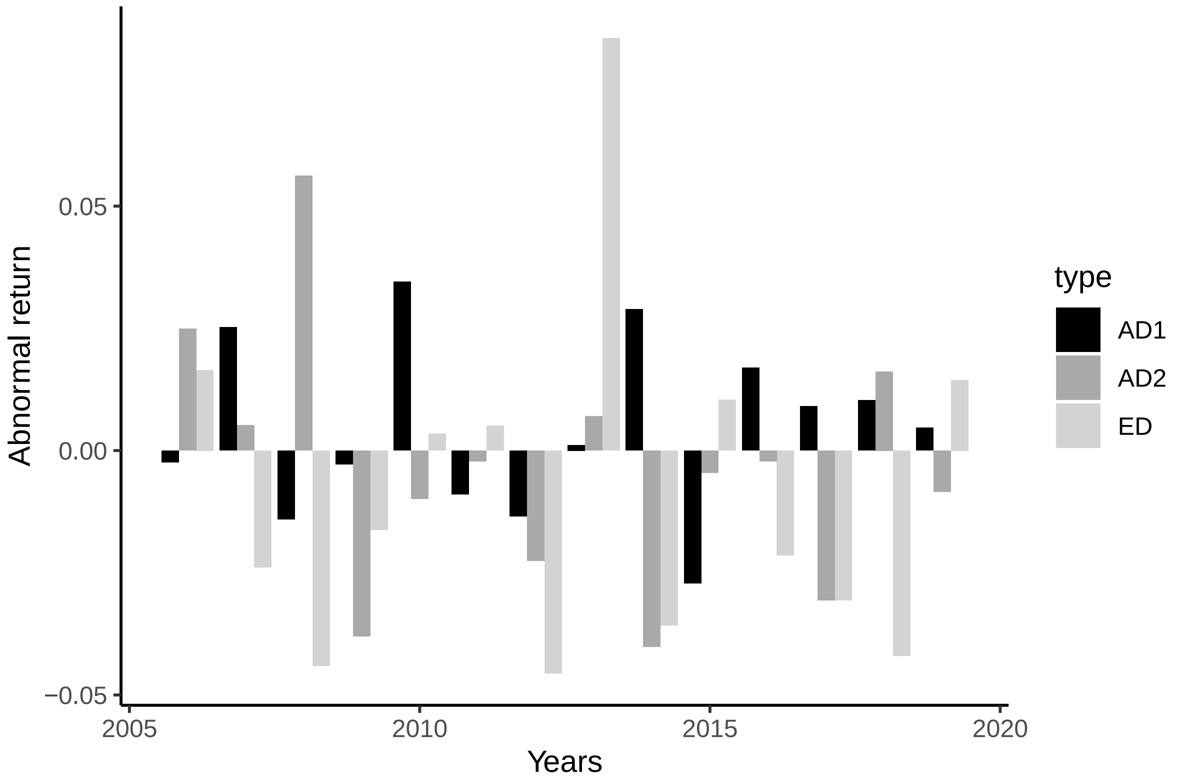
Figure 2.1 shows the performance of the Invesco Global Clean Energy ETF, which tracks the NEX index, compared to the S&P 500 index. Figure 2.1 shows that the NEX index has underperformed compared to the S&P 500. If the clean energy sector underperforms compared to the broad market, investors might perceive clean energy initiatives as unprofitable, meaning that inclusion in the index could be view as a negative signal and cancel out other positive effects.

On a more general note, the clean energy space is still at an early stage in terms of the life cycle but is already exceeding investments in new fossil fuel generating projects (United Nations, 2019). As such, the sector is more mature today compared to 2006. With that in mind, one would expect to see increased positive abnormal returns towards the end of the series.

Figure 8.1 shows the development in abnormal returns for the different event windows.

The plot reveals no distinct pattern. Therefore, it is not possible to explain the lack of findings by a sentiment shift in the clean energy space in recent years.

Figure 8.1: Development in abnormal returns



Note: The clustered barchart shows the development of ACAR from 2006 to 2019 for the respective event windows.

Another explanation for stock price changes around inclusion is the so-called index effects. Several studies have shown that stocks included (excluded) in an index exhibit significant positive (negative) abnormal returns around inclusions. There are several reasons for this (note that signaling is also a possible explanation to index effects):

One possible explanation is related to the price pressure hypothesis, which assumes that prices should increase around the announcement or the rebalance date of the index, because of increased demand by active managed funds and ETFs that tracks the index, are forced to rebalance their portfolios. All else equal, this should yield a temporary increase in the price of new index members. However, the price pressure hypothesis is conditional on the size of the funds and ETFs that tracks the index.

Table 8.2: Average daily volume of selected ETFs

Ticker	Fund Name	Issuer	AUM MUSD	Average daily volume MUSD
ICLN	iShares Global Clean Energy ETF	Blackrock	667,32	6,23
TAN	Invesco Solar ETF	Invesco	607,13	8,58
PBW	Invesco WilderHill Clean Energy ETF	Invesco	305,68	2,72
QCLN	First Trust NASDAQ Clean Edge Green Energy Index Fund	First Trust	206,22	1,83
ACES	ALPS Clean Energy ETF	SS&C	184,45	1,00
SMOG	VanEck Vectors Low Carbon Energy ETF	VanEck	109,23	0,28
FAN	First Trust Global Wind Energy ETF	First Trust	99,95	0,29
PBD	Invesco Global Clean Energy ETF	Invesco	62,97	0,23
YLCO	Global X YieldCo & Renewable Energy Income ETF	Mirae Asset	49,02	0,21
CNRG	SPDR S&P Kensho Clean Power ETF	State Street Global Advisors	24,87	0,33

Note: The table displays assets under management and average trading volume over the last 45 trading days for selected ETFs within the clean energy space. The data is retrieved from etf.com.

Table 8.2 shows that the Invesco Global Clean Energy ETF, which tracks the NEX index has $305.68 million in assets under management (AUM) and is one of the most liquid ETFs for clean energy investing. In contrast, SPY, the ETF which tracks the S&P 500, has $269.60 billion in AUM and a daily average volume of $28.49 billion. Daily volume can be viewed as a proxy for how popular a particular ETF is. However, volume alone cannot explain "expected" price pressure, as the price reaction is also conditional on the market capitalization and trading volume of the companies tracked by the ETF. Hence, an "apples to apples comparison" of ETFs is difficult, even though the NEX ETF is not small compared to its peers. Nevertheless, there could be a price pressure effect, evidenced by the significant volume increase at the effective date (see Table 8.5, day 0), perhaps canceled out by effects like those proposed in the sustainability redundancy hypothesis of Cheung and Roca (2013).

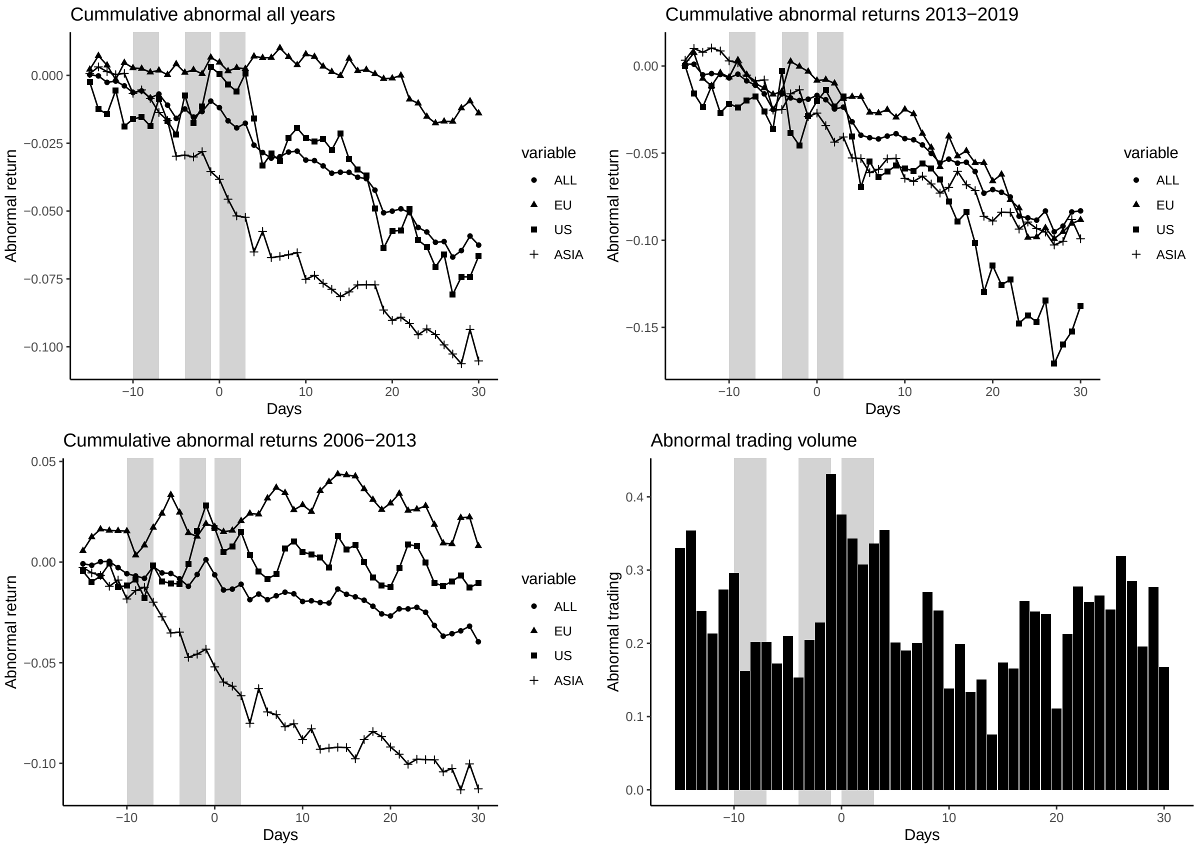
This study also tried to compare trading volume for the Invesco Global Clean Energy ETF with ETFs that track ESG indices from previous studies, to check whether our lack of findings could be accounted for by a low investor awareness compared to the other indices. However, most of the ETFs are created in more recent times. As such, we are unable to find sufficient volume data for the period that the previous studies are conducted. Therefore, it is difficult to conclude whether the lack of findings is due to the size of the Invesco Global Clean Energy ETF.

According to the liquidity hypothesis, index inclusion increase information, and reduces information asymmetries, which increase trading volume and lower bid/ask spreads. As a consequence, the stocks are less expensive to trade, as transaction costs are lower, which advocates price increases. The awareness hypothesis also proposes positive price effects from increased liquidity. Abnormal trading volume increases around inclusion, so the positive price effects from increased liquidity might be offset by negative effects e.g., from investors who view sustainability as redundant.

Lastly, the sustainability taste hypothesis of Cheung and Roca (2013) proposes that investors with tastes or preferences for sustainable firms can obtain additional utility from their holdings of the shares of these firms, on top of the utility that they can get from the returns from these shares. Hence, inclusion in an ESG index could result in a price increase due to excess demand from this group of investors. The problem with applying this hypothesis to the NEX is that the companies included in the NEX are companies where sustainability is already embedded in their core business. As a result, investors with a taste for sustainability could already be invested in or aware of the included companies. Consequently, inclusion in the NEX might not move their utility enough to increase prices significantly. Another possibility is that the sustainable investor segment is too small to make a significant impact on prices, although such investors value inclusion in the NEX.

8.1.2 Long-term effects

Table 8.3: ACAR and abnormal trading volume



Note: The figure shows the development of cumulative average abnormal returns and abnormal volume for the whole event window [-15,30]. Shaded areas denote the event window AD2, AD1 and ED, respectively (from left to right).

Figure 8.3 illustrates the development of ACAR and abnormal trading volume for different periods and regions. The long-term event window, [-15,30], which captures the combined effects of pre-announcement, announcement, and post inclusion effects, shows significant negative abnormal returns. One explanation for these conflicting findings could be found in the sustainability redundancy hypothesis. The hypothesis proposes negative abnormal returns with inclusion in an ESG index, as implementing additional environmental measures are viewed as costly and a deviation from profit maximization. This leads to inclusion being perceived as a negative signal by investors and could cancel out other positive effects from inclusion. Another explanation could be the length of the event window. This is because the risk of spurious effects increase dramatically for event windows as large as 45 days, as longer event windows increases the risk of confounding events and statistical noise (Brown and Warner, 1980; MacKinlay, 1997). As the main windows in this research are mostly insignificant, it is hard to draw any conclusions based solely on the long-term windows.

8.2 Cross-sectional analysis

To extend the analysis, a cross-sectional analysis based on the cumulative abnormal return (CAR) is conducted, to test the relationship between individual firms' abnormal returns, firm-specific variables and geographical affiliation. The results from the cross-sectional analysis is presented in table 8.4.

Table 8.4: Cross-sectional analysis

	Dependent variable:
	CAR
P/B	0.001
	(0.001)
P/E	−0.0002
	(0.0002)
D/A	−0.0003
	(0.0003)
Ln_Mcap	0.006
	(0.006)
$D1_{US}$	−0.004
	(0.017)
$D2_{ASIA}$	−0.007
	(0.017)
Constant	−0.034
	(0.044)
Observations	109
R^2	0.034
Adjusted R^2	−0.023
Residual Std. Error	0.071 (df = 102)
F Statistic	0.602 (df = 6; 102)

Note: the table shows the results of regressing the CARS from window [0,3] around ED on firm-specific variables and region dummies. Europe is the baseline region. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

The cross-sectional analysis does not offer much in explaining the sign of the CARs. None of the explanatory variables are significant, and the model has low explanatory power, represented by a low R-squared. In conclusion, neither the selected valuation metrics nor a securities affiliation can explain the sample companies' abnormal returns around inclusion in the NEX index.

8.3 Abnormal trading volume

According to hypotheses **2A** and **2B**, this study expects to find positive abnormal trading volume around the announcement and the inclusion date.

Table 8.5: Results: abnormal trading volumes

Day	Abnormal volume	T-stat	Day	Abnormal volume	T-stat	Day	Abnormal volume	T-stat
30	0,17	0,90	15	0,17	0,93	0	0,38	2,01**
29	0,28	1,48	14	0,08	0,40	-1	0,43	2,31**
28	0,20	1,05	13	0,15	0,81	-2	0,23	1,22
27	0,29	1,53	12	0,13	0,71	-3	0,20	1,09
26	0,32	1,71*	11	0,20	1,07	-4	0,15	0,82
25	0,25	1,32	10	0,14	0,74	-5	0,21	1,12
24	0,27	1,42	9	0,24	1,31	-6	0,17	0,92
23	0,26	1,37	8	0,27	1,44	-7	0,20	1,08
22	0,28	1,48	7	0,20	1,07	-8	0,20	1,08
21	0,21	1,14	6	0,19	1,02	-9	0,16	0,87
20	0,11	0,59	5	0,20	1,08	-10	0,30	1,58
19	0,24	1,28	4	0,35	1,90*	-11	0,27	1,47
18	0,24	1,30	3	0,34	1,80*	-12	0,21	1,14
17	0,26	1,38	2	0,31	1,65	-13	0,24	1,31
16	0,17	0,89	1	0,34	1,84*	-14	0,35	1,89*
						-15	0,33	1,77*

Note: The table display abnormal trading volume. Day 0 denote the ED, while day -10 and -4 denote AD2 and AD1 respectively.
$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

The results in table 8.5 reveal that inclusion in the NEX index yields positive significant abnormal trading volume on day -1, 0 (where 0 is the effective date) at the five percent level, and on a ten percent level on three of the four following days. This is in line with Hypothesis **2B**. However, this study does not find any significant increase in trading volume around the announcement date. Thus, Hypothesis **2B** is accepted, while Hypothesis **2A** is rejected. The positive volume effects around the effective date can, in part, be explained by the price pressure Hypothesis and the downward sloping demand curve Hypothesis. However, according to these hypotheses the volume effects should be accompanied by positive returns, as the hypotheses are based on the assumption that ETFs and index funds buy included stocks and contribute to a significant price increase this way. Evidently, this is not the case for inclusions in the NEX.

Nevertheless, it appears to be the case that companies receive more attention after inclusion, backed by the increased volume effects. As the returns are insignificant on these dates for the full sample, the significant abnormal volume increase could be interpreted as a lacking consensus on whether inclusion is a positive or negative signal. Note that the change in volume happens with a lag of 10 days after the information is made public. This is contrasts with the expectations presented in sections 4 and 5, as an efficient market would absorb the information closer to the day it is made public.

9 Conclusions and suggestions

9.1 Conclusions

This thesis analyzes whether the market rewards inclusion in the NEX Index by measuring the effects on share price and trading volume of new index members. Market reactions are measured by studying abnormal returns and abnormal trading volumes around the announcement of the new index composition and the effective rebalance date. The broad aim of this study is to explore whether investors value exceptional environmental contributions from a company, with inclusion in the NEX index being a proxy for environmental performance.

We observe no significant positive price effect around the date of the announcement nor the effective rebalance date, and are forced to reject our hypotheses. However, there seems to be an increasingly negative view on inclusion for stocks added in the later period, 2013-2019. This indicates an increasingly negative view of exceptional environmental performance, contrary to expectations after examining the literature on ESG indices (Becchetti et al., 2007; Chakarova & Karlsson, 2008; Curran & Moran, 2007; Durand et al., 2019; Hawn et al., 2018).

We do, on the other hand, observe some conflicting findings between different regions. American stocks display significant positive abnormal returns around announcement for the period 2006-2013, while Asian stocks display significant negative abnormal returns prior to AD1 for the period 2006-2013. This may indicate that Asia and the Pacific view environmental performance as bad for business, and that US investor responses have changed from positive to ambiguous over the years.

A possible explanation to the price reactions in Asia is the sustainability redundancy hypothesis of Cheung and Roca (2013), which argues that investors view a sustainability focus as costly and sub-optimal, and therefore punish companies included in sustainable indices. Similarly to us, they find that Asian investors penalize inclusion in an ESG index. Nevertheless, the findings from Asia are only significant at the ten percent level and in stark contrast to the theoretical framework which our hypotheses are built on. Therefore, we argue that these conflicting findings must be examined more carefully before we are able to draw any robust conclusions.

Additionally, the sustainability redundancy hypothesis could explain the lack of significance for the full sample. Investors with a sustainability redundancy view might cancel out any positive effects from other investor segments, leading to insignificant price effects overall.

Looking at trading volumes, we find significant positive abnormal volumes both before and after the effective date, which implies that inclusion increases the liquidity of a stock. Therefore, it could be argued that inclusion in the NEX Index seems to increase attention around the included stocks, but that the price reactions are ambiguous.

In conclusion, this study fails to give any clear evidence on the expected positive link between environmental acclaim and financial performance. Nevertheless, it appears to be the case that companies receive more attention after inclusion, backed by the increased volume effects.

9.2 Limitations and suggestions for further research

As in any study, there are several ways to approach the research problem. Methodological decisions could influence the results, e.g., what model to use for (ab)normal returns and what test statistic to use. These questions are particularly important for a multi-country event study.

This study uses Russell 2000, MSCI AC Europe Small-cap Index and MSCI AC Asia Small-Cap Index as proxies for the market return in the respective regions. As these are regional indices, country-specific events could be averaged out, and thus the selected indices might fail to capture country-specific events. As such, abnormal returns on certain days could be biased, which in turn will influence the standard errors.

Furthermore, this study estimates normal returns by applying a single-factor model. In a multi-country event study, country-specific factors such as currency exchange rates, economic growth, inflation and interest rates could significantly influence stock returns. This could be in favor of a multi-factor model, although previous research (Lundgren and Olsson, 2010) find only marginal differences in explanatory power between a market model with country-specific indices and multi-factor models.

Another possible bias arises from the lack of synchronism in trading hours. Given the 5-6 hours difference between Europe and America, trading allows for overlapping, and the market can react to new information the same day. However, there is a roughly 12-hour difference between American and Asian countries. Hence, trading hours do not overlap (Park, 2004). Thus, investors are unable to react simultaneously to announcements. This makes it difficult to measure the index effects over a short event window.

The clean energy space is still at an early stage in terms of its life cycle, and with capital increasingly allocated towards solutions to climate change, its reasonable to assume that members of the NEX Index will see increased attention in the coming years. As such, we suggest that a similar study is conducted again in some years with new event data. To extend the analysis beyond price and volume, future studies could compare how frequently the company name or ticker is typed into Google's search engine before and after inclusion. We performed a similar analysis on a sample of companies, but did not find signs of any patterns in the search data. However, this might change with time, as the index becomes more renowned.

Lastly, this study does not measure the impact on security prices or abnormal trading volume of securities excluded from the index. Adding a study of the companies excluded from the index while controlling for corporate events would give a more comprehensive analysis of the index effects.

To ensure robust conclusions, we suggest that this study is replicated by using national indices as a proxy for the market and a multi-factor model to estimate (ab)normal returns. One could also apply the event study method to similar indices, like the S&P Global Clean Energy Index or the MSCI Global Climate Select Index, to validate the findings of this study.

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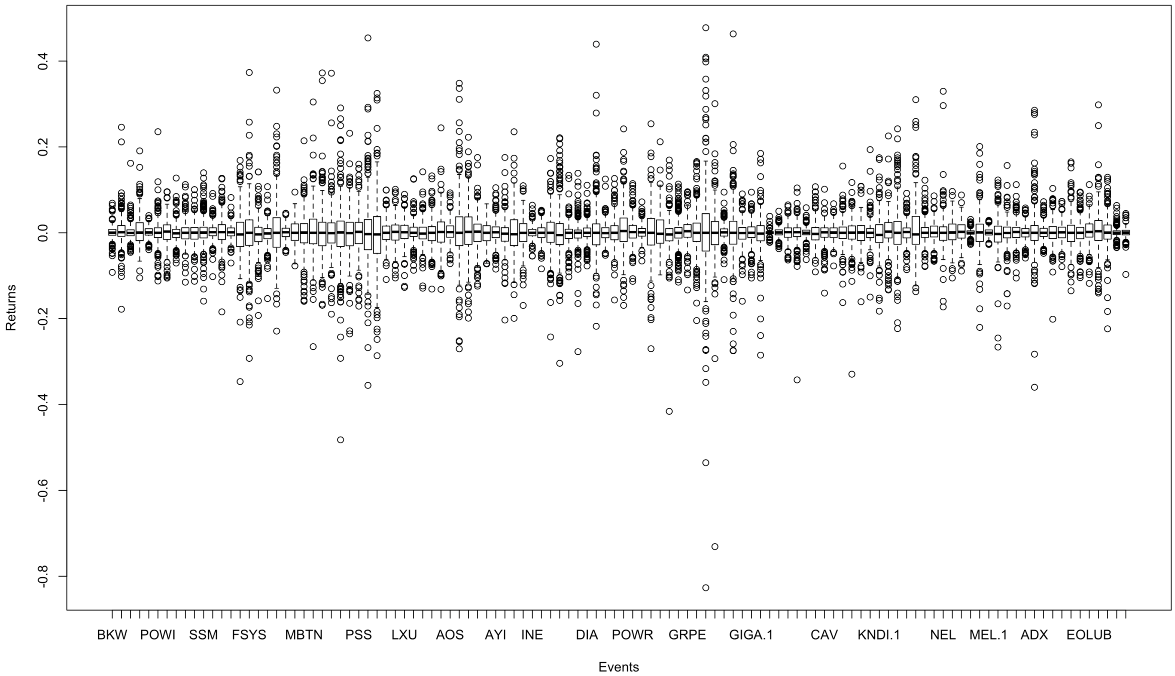
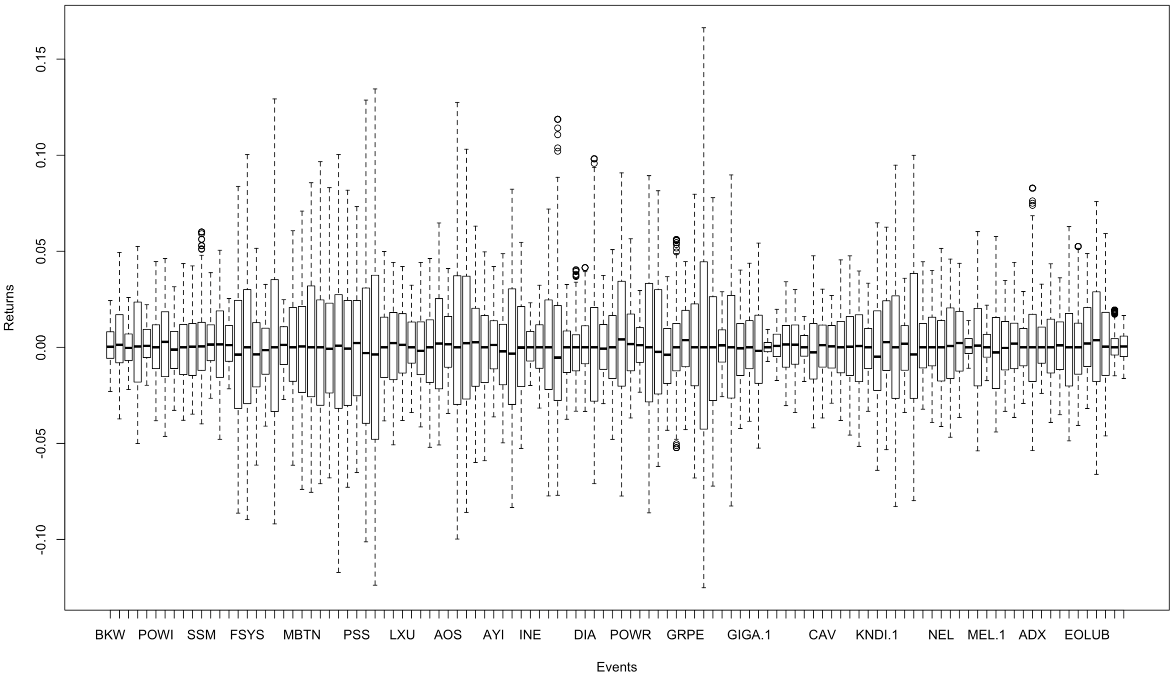
Appendix

Figure A0.1: RAW data



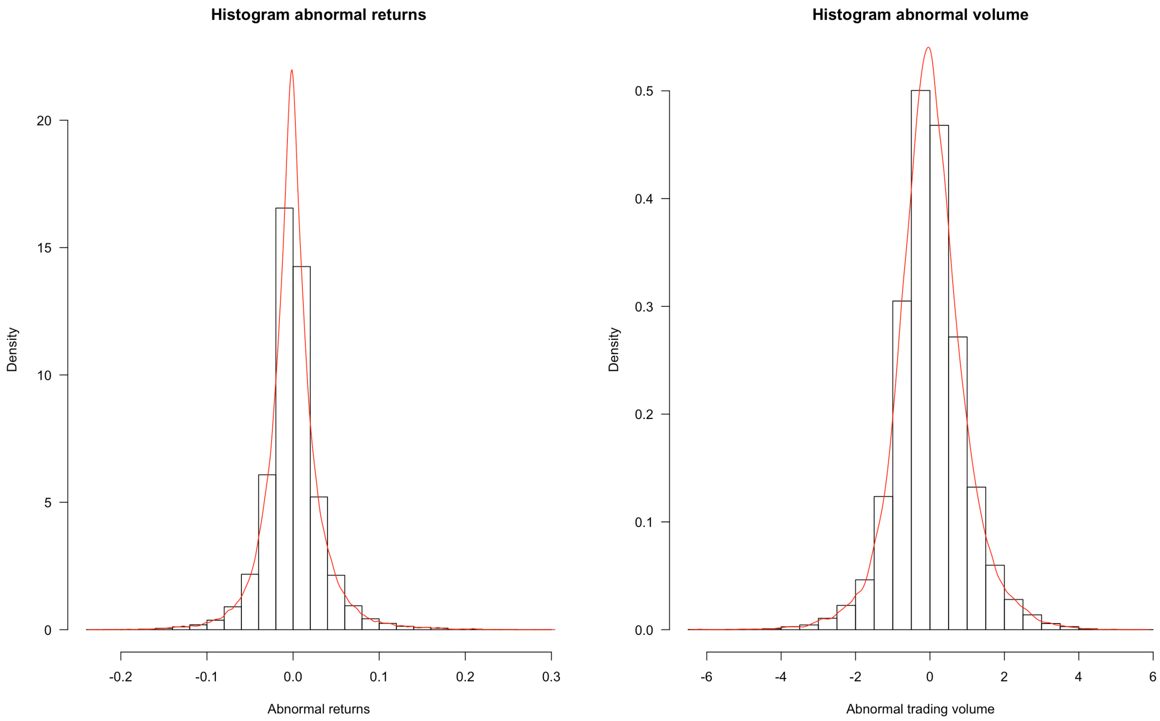
*Note: Boxplot of unprocessed data (log returns). Upper bound: Q3 + 1,5 * IQR, Lower bound: Q1 - 1,5 * IQR. Single dots represent observations outside the bounds and are categorized as outliers.*

Figure A0.2: Winsorized data



Note: Boxplot of cleaned data. The data is winsorized at the 5th and 95th percentiles, which means that extreme values are replaced with less extreme values.

Figure A0.3: Histogram of distribution

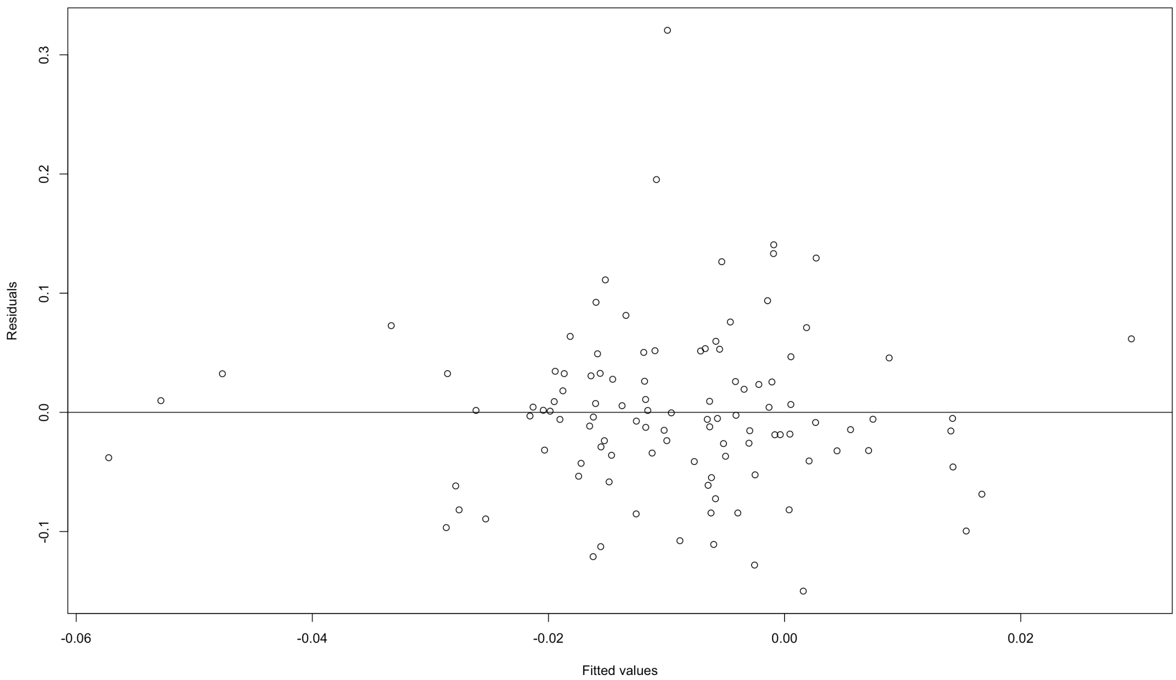


Note: Histogram of log-transformed abnormal returns and abnormal trading volume. The data appears to follow a bell curve, which gives confidence that the normality assumption holds.

The use of log-returns follows the assumption that stock prices follow a log-normal distribution. Log returns have some favorable properties for statistical analysis. As log-returns follows a normal distribution, statistical tests that assume a normal distribution could be utilized, such as the Student t-test.

One of the assumptions for the tests to be reliable is that the data follows a normal distribution. If the data do not follow a normal distribution, all results would be asymptotic (MacKinlay, 1997). Figure A0.3 shows the distribution for abnormal returns and abnormal trading volume. The data appears to follow a bell curve, which gives confidence that the normality assumption holds.

Figure A0.4: Residuals of regression plotted against fitted values



Note: Residuals from the cross-sectional analysis plotted against fitted values to test for heteroscedasticity.