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Performance and Efficiency of the Nordic Exchange Traded Fund Market

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Abstract

ETFs are experiencing rapid growth as a passive investment instrument. Due to the recent MiFID II and PRIIPS regulations, Nordic ETFs are becoming increasingly relevant for European investors. With the purpose of informing investors about the dynamics of the Nordic ETF market, this paper studies the performance and efficiency of 17 leveraged and unleveraged Nordic equity ETFs. We analyse the return, tracking efficiency and pricing efficiency of the funds, how the leveraged and unleveraged ETFs behave differently and how Nordic ETFs differ from ETFs in other markets. The results show that while unleveraged Nordic ETFs generally underperform their benchmarks by 1% every year, they experience a higher tracking and pricing efficiency than ETFs studied in other markets. As a result of a generally bullish market, we see that it has been more attractive to hold bull ETFs than bear ETFs in the long term. The tracking efficiency of leveraged ETFs is shown to differ between funds, where some funds manage to hold their multiple for a holding period of one month. We also see that price deviations behave differently between bull and bear ETFs. While both tracking error and price deviation are found to be persistent, their determinants differ. Price deviation is found to be negatively correlated to liquidity, fund size and fund flow, while tracking error is positively correlated to expense ratio.

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1 Introduction

Exchange traded funds (ETFs) are passive investment instruments that have experienced a remarkable growth, with a total increase in worldwide assets under management of 1,675% between the years 2003 and 2016 (Deutsche Bank 2017). In 2018, the value of the global ETF market reached an all-time high of 5 trillion U.S. dollars, and the industry is expected to continue its rapid growth with Europe as a main driver (Hu 2018; KPMG 2018).

ETFs have characteristics that make them a mix between open-ended mutual funds and stocks. Similar to stocks, ETFs are traded openly on the stock market. Similar to index mutual funds, ETFs hold a basket of securities that represent an underlying benchmark. The benchmark can consist of equity, fixed income, commodities or specific broad indices (Rompotis 2011). As a result of the unique characteristics of ETFs, the instrument offers benefits over other forms of index tracking products in terms of tax efficiency, intraday trading, low costs and cost transparency (Gastineau 2010, p. 7-12). The unique characteristics of ETFs also create determinants of performance that are specific for ETFs.

As the purpose of the ETFs is to replicate the underlying benchmark as closely as possible, it is this ability that is measured when evaluating their performance. For mutual funds, the performance is solely dependent on the net asset value (NAV) of the fund. For individual stocks, the performance is determined by market price. For ETFs, performance is determined by both NAV and price. In order to measure the impact of the two aspects on performance, we introduce two measures: Tracking error and price deviation. Tracking error is the deviation of the NAV of the ETF from the NAV of the benchmark and presents how well the fund provider succeeds in replicating the return of the benchmark. Through the accumulation of tracking error over time, the long-term performance of the ETF is affected (Charupat & Miu 2013a). Price deviation is defined as the difference between the ETFs price and NAV and evaluates the impact of the stock market. ETFs have a unique creation and redemption process, where Authorized Participants (APs) act as markets makers. They redeem and create fund units when arbitrage opportunities emerge, and as a consequence act to minimize them (Charupat & Miu 2011).

Although ETFs have become a common investment form, the history of the ETF market is relatively short compared to other types of funds. The first version of the ETF was introduced in Canada 1989, and four years later the first American ETF, the S&P 500 SPDR, was introduced (Gastineau 2010, p. 2). Since then, the ETF market has expanded internationally and grown to include new types of ETFs, such as leveraged and leveraged inverse ETFs, often called bullish and bearish ETFs (Rompotis 2014). Leveraged and leveraged inverse ETFs generate daily returns that are a positive or negative multiple of the daily returns of their benchmarks and are therefore more speculative in nature than traditional unleveraged ETFs (Charupat & Miu 2011). The new product was first introduced 2005 by the Swedish fund provider Xact and launched only a year after in the U.S. (Xact n.d.; Charupat & Miu 2011). Today, leveraged ETFs constitute 40%[1] of all Nordic ETFs.

As a result of the recent popularity of ETFs, several studies have been conducted on their performance. However, due to the short history of the instrument and a leading ETF market within the U.S, the scope of the studies has, with few exceptions, been limited to the U.S. Despite being the birthplace of leveraged ETFs, the Nordic ETF market has been slow in adopting the investment type, and limited research on the market exists. The first Nordic ETF, the Xact OMXS30, was listed in Sweden year 2000 (Bioy 2010). Today there are in total 20 Nordic ETFs, where a Nordic ETF is defined as an ETF listed in Sweden, Norway, Denmark, Finland or Iceland that has been issued by an ETF provider from the same region. 18 of the 20 ETFs have equity benchmarks, while the remaining have commodity and fixed income.

In 2017, the ETF provider Xact dominated the market with a share of just over 94% of the total turnover within the Nordic ETF market (Xact 2018). The distribution between countries is fairly uneven, where Sweden has twelve ETFs listed on a Swedish stock exchange. Four ETFs are listed in Norway, one ETF is listed in Finland and one ETF is listed on Iceland. Due to regulatory and tax issues, there are no ETFs listed in Denmark (Bioy 2010).

In January 2018, the European legislative frameworks MiFID II and PRIIPS came into force, which may have substantial implications for the Nordic ETF market. Due to the tougher requirements of information and documentation to investors, most Swedish banks are no longer able to offer the 2,500 U.S.-listed ETFs to their clients (Privata Affärer 2017; Hemberg 2017; Trouin 2017). Nordic investors will thus have to go through European providers when investing in ETFs, which could mean an increase in demand of Nordic ETFs. Furthermore, it is also likely that the increased transparency demanded by MiFID II and PRIIPS will spur further growth in the ETF market, since the historical lack of information has been reported to deter investors (Thompson 2018).

Due to the increasing relevance of the Nordic ETF market as a result of the MiFID II and PRIIPS regulation as well as predicted market growth, there is need for further research of the Nordic ETF market. Our thesis will serve to fill that gap and is the first study to examine the performance of the Nordic ETF market. Given the risk of underperformance due to tracking error and price deviation, it is important to understand the determinants of performance and how they may cause market inefficiencies, before investing. It is also essential to understand how traditional and leveraged ETFs behave differently, and what implications this has for the investor. By studying

[1] Computed as the number of Nordic leveraged ETFs divided by the total number of Nordic ETFs.

the performance of traditional and leveraged Nordic ETFs, we conduct a comparative study that aims to help the investor make informed investment decisions. Due to the unique history and structure of the Nordic market, our findings are interesting to compare to existing studies of other markets.

The findings of our study indicate that there are differences between the Nordic ETF market and other studied markets. Although Nordic traditional ETFs tend to underperform their benchmark with approximately 1% per year, they have smaller tracking error compared to ETFs in other markets. As a result of a generally bullish market during the examined period, bull ETFs have outperformed their benchmarks with an average of approximately 5% when NAV return is used. Consistent with previous studies, leveraged ETFs are shown have higher tracking error than traditional ETFs. However, the performance differs between funds. As the holding period increases, some leveraged ETFs deviate quickly from the multiple while others manage to hold their promised returns for a holding period of one month. Furthermore, we find that both tracking error and price deviation are persistent. While tracking error is positively correlated to expense ratio, price deviation is positively correlated to benchmark volatility and negatively correlated to liquidity, fund size and fund flow. The average price deviation is small, but since we observe substantial fluctuations in the magnitude of price deviation, large premiums and discounts do occur. We also find that price deviations behave differently for bull and bear ETFs.

2 Literature Review

This section outlines the existing literature on the tracking efficiency and pricing efficiency of ETFs. Due to the different characteristics of traditional ETFs and leveraged ETFs, we have divided them into separate sections under respective area.

2.1 Tracking Efficiency

2.1.1 Tracking Efficiency of Traditional ETFs

In existing research on ETFs, tracking error is highlighted as a factor that significantly affects long-term performance of the funds. Typically defined as the deviation of the NAV return of an ETF from the NAV return of the underlying benchmark, tracking error can accumulate over time and result in systematic under- or overperformance (Charupat & Miu 2013a). Shortcomings in holding the exact index could result in both inferior and superior performance. However, when transaction costs and management fees are taken into consideration, the total effect on performance is expected to be small (Elton et. al. 2002).

Elton et. al. (2002) conduct a performance study on U.S. SPDRs, one of the first generations of ETFs. Their findings indicate that ETFs underperform their corresponding underlying benchmarks by 28.4 basis points every year. Rompotis (2011) studies the persistence of tracking error of ETFs for 50 iShares listed in the U.S. Differently from Elton et al. (2002), the author finds that 42 out of 50 ETFs tend to outperform their respective benchmark. The outperformance of NAV returns amounts to an average of 41 basis points before taking management fees and other expenses into consideration.

Shin and Soydemir (2010) examine tracking error of ETFs listed in the U.S. The authors find that ETFs tracking domestic indices have an average daily tracking error of 0.0283%, while ETFs tracking international indices have an average tracking error between 0.0691% and 0.1514%. Chu (2011), who studies tracking error of ETFs listed in Hong Kong finds that daily tracking error ranges from 0.2786% to 2.1736%. Both domestic and international indices are represented in the sample of the study. The author concludes that tracking error of Hong Kong-listed ETFs is significantly higher than tracking error of ETFs listed in the U.S. or Australia, which have more developed ETF markets. Purohit and Malhotra (2015) find a similar pattern in the Indian market, where daily tracking error of Traditional ETFs ranges from 0.5680% to 0.9100%. Furthermore, Baş and Sarıoğlu (2015) find that the average daily tracking error of traditional ETFs listed in Turkey amounts to 0.5303%.

Research identifies a number of factors that could explain the magnitude of tracking error of ETFs. For example, the findings of Shin and Soydemir (2010) indicate that the level of tracking error is determined by the location of underlying index, where ETFs tracking international indices have higher tracking error than ETFs tracking domestic indices. Furthermore, studies by Rompotis (2011) and Milonas and Rompotis (2006) find that tracking error is significantly correlated with market risk. Qadan and Yagil (2012), who examine how the tracking ability of ETFs was affected by the last financial crisis, confirm that ETF experience higher tracking error when the market is more volatile.

Other studies show that fund expenses party explain tracking error (Elton et al. 2002; Rompotis 2011; Chu 2011). Just as other passive investment forms, ETFs charge a small management fee, which is charged as a percentage of assets under management. The NAVs of the funds factor-in these expenses, which naturally increases tracking error. However, the studies also conclude that fund expenses do not fully explain the observed tracking inefficiencies.

Further possible drivers of tracking error that have been highlighted by existing research are fund age, paid dividends, fund size and liquidity of the fund and the benchmark (Meinhardt et al. 2015; Singh & Kaur 2016; Rompotis 2011). For instance, ETFs with larger assets under management are shown to experience lower tracking error than smaller ETFs, due to economies of scale (Singh & Kaur 2016).

Studies that investigate the impact of replication strategy on tracking error have received inconsistent results. ETFs that use a synthetic replication strategy, where derivatives are used to replicate the underlying benchmark, are shown to have both higher and lower tracking error than ETFs that use a physical replication strategy, where the actual securities are hold (Naumenko & Chystiakova 2015; Meinhardt et al. 2015).

2.1.2 Tracking Efficiency of Leveraged ETFs

Since the objective of leveraged ETFs is to achieve a predetermined multiple of the return of their benchmark on a daily basis, tracking error of leveraged ETFs occurs when the return deviates from the multiple. As a result of the use of leverage, tracking error of leveraged ETFs does not only depend on the factors that determine the tracking error of traditional ETFs, but is also affected by the length of the holding period. Since the funds use a constant leverage ratio to achieve their multiple, they have to be rebalanced daily to maintain the desired exposure to the benchmark. The resulting compounding effect is shown to cause tracking error when the holding period is longer than one day (Charupat & Miu 2011).

Charupat & Miu (2011) investigate the tracking efficiency of Canadian leveraged ETFs. They conclude that leveraged ETFs can provide the promised performance – the stated ratio returns – over a holding period up to a week. Tracking error is also shown to be larger when the underlying return is more volatile. The finding highlights an important characteristic of leveraged ETFs, where the fund can obtain negative return in a non-trending market if it is volatile (Charupat & Miu 2011). Similar conclusions are made by Lu et al. (2012), who study the long-term performance of four pairs of bull and bear ETFs in the U.S market. The authors find that performance is negatively correlated to holding horizon. Only during short holding periods can leveraged ETFs live up to the stated objectives. Furthermore, the relationship is stronger for bear than for bull ETFs. Bear funds have difficulty tracking the underlying indices for holding periods of one quarter or longer, in contrast to bull funds which have difficulty in tracking for one year or longer.

Another study, by Murphy and Wright (2010), conclude that the underperformance of the ETFs is a function of the volatility of the underlying indices. The authors also advise against using these ETFs as a part of a "buy-and-hold" investment strategy, which is in line with the findings of Charupat and Miu (2011) and Cheng and Madhavan (2009). Charupat and Miu (2011) state that leveraged ETFs primarily appeal to short term investors with an average holding period of under 15 days. Similarly, Cheng and Madhavan (2009) conclude that the embedded path-dependency of leveraged ETFs reduces value for a "buy and hold" investor.

In contrast to other studies, Shum and Kang (2013) do not only focus on the compounding effect on the performance of leveraged ETFs. Instead, they decompose the performance of ETF into three dimensions: Compounding, premium/discounts and management factors. Premium/discounts represent the efficiency and liquidity of the market and management factors represent the costs and effectiveness of the replication strategy. The authors find that the impact of management factors could partly offset the compounding effect for some ETFs. Furthermore, they find that bear ETFs tend to deviate faster than bull ETFs from their multiple as the holding period increases.

2.2 Pricing Efficiency

2.2.1 Pricing Efficiency of Traditional ETFs

Since ETFs trade freely on the stock market, it is possible for prices to deviate from the NAVs of the funds. In liquid markets with no limits to arbitrage such deviations should not occur, but existing research suggests that market frictions and impediments to information are expected to lead to mispricing that can affect the returns of the funds (Ackert & Tian 2008). Through the creation and redemption mechanism of ETFs, the price deviations are sought to be minimized. The APs are allowed to buy or sell units of ETFs directly from or to the fund provider at the NAVs of the ETFs. This way, arbitrage opportunities are exploited to keep market prices close to the NAVs (Charupat & Miu 2011).

Previous research on pricing efficiency of traditional ETFs listed in the U.S. finds that price deviation of ETFs that track domestic indices are generally small in magnitude and tend to disappear within a day (Ackert & Tian 2000; Elton et al. 2002). However, Ackert & Tian (2000) find that in the case of SPDR MidCap, significant mispricing occurs, and the fund is generally traded at a discount. The authors connect the finding to higher arbitrage costs, which are a result of higher transaction costs, lower dividend yields and higher fundamental risk (Ackert & Tian 2000).

Pricing efficiency of ETFs is shown to vary between markets. One U.S.-listed ETF is shown to have an average price deviation of -0.018%, while a sample of Canadian ETFs is shown to trade with an average price deviation of 0.0371% (Elton et al 2002; Lin et al 2006). Another study of U.S.-listed ETFs concludes that the ETFs have an average price deviation of -0.0121% (Charupat & Miu 2013b). In a study by Purohit & Malhotra (2015), Indian ETFs are shown to generally trade at a discount. The authors also find that the average persistence of price deviation is three to five days. In another study, Taiwanese ETFs are found to trade at an average premium of 0.041% (Lin et al. 2005). Price deviations in South Africa are shown to be -0.0368% (Charteris 2013).

Larger price deviations are shown to occur for ETFs that follow international indices or have illiquid underlying assets since NAV is harder to determine for these ETFs (Engle and Sarkar 2006; Ackert & Tian 2008; Petajisto 2017). Ackert and Tian (2008) conclude that the variation in price deviation is especially large (more than 10 basis points) for funds with international benchmarks but are on average small (less than 2 basis points) for funds with domestic benchmarks. The authors find liquidity, momentum and size effects to have implications for the pricing efficiency. This result is consistent with the findings of Engle and Sarkar (2006). They study the magnitude of price deviations for domestic and international ETFs and conclude that premiums and discounts are larger and more persistent (often lasting several days) for international ETFs. One explanation for this is higher cost in the creation and redemption process for ETFs with international underlying securities.

2.2.2 Pricing Efficiency of Leveraged ETFs

Since leveraged ETFs seldom hold the underlying securities, and instead use derivatives to generate promised return, they apply an in-cash procedure in the creation and redemption process. Most traditional ETFs hold the underlying securities and use an in-kind creation and redemption process.

The in-cash process is more complicated than the in-kind process, which increases the arbitrage bounds of leveraged ETFs (Charupat & Miu 2011).

Charupat and Mui (2013b) examine the pricing efficiency of leveraged ETFs in U.S. and conclude that price deviations of leveraged ETFs are generally small and within the bounds of transaction costs and bid-ask spreads. However, leveraged ETFs can experience larger premiums and discounts than traditional ETFs and the deviations depend on the leverage ratio, where a higher ratio results in larger price deviations (Charupat & Miu 2013b). Similar conclusions are made in another study by the authors, which examines the pricing of Canadian ETFs. The results show that while leveraged ETFs are generally priced close to NAV, high standard deviations indicate that large premiums and discounts do occur. Charupat and Miu (2011 and 2013b) conclude that there is a positive relationship between leverage ratio and volatility of price deviations. This is consistent with the findings of Engle and Sarkar (2006), who conclude that the volatility of the fund NAV is positively correlated with the volatility of the price deviation.

Moreover, there are differences in the pricing efficiency depending on whether the leveraged ETF is a bull or a bear ETF. Charupat and Miu (2011 and 2013b) show that bear ETFs tend to trade at a premium whereas bull on average trade at discount. The average price deviation of U.S.-listed bull ETFs with a multiple of 2 is found to be -0.0399%, whereas the average price deviation of Canadian bull ETFs with the same multiple is -0.0209%. For U.S.-listed bear ETFs with a multiple of 2 the average price deviation amounts to 0.0033% and for corresponding Canadian ETFs it amounts to 0.0612%. Charupat and Miu (2011 and 2013b) also discover differences in the dynamics of the pricing of bull and bear ETFs in relation to the returns of their respective benchmarks. When the return of the underlying benchmark is positive (negative), bull (bear) ETFs tend to trade at discount (premium).

3 Theory & Methodology

3.1 Problematization and Contribution

Existing research on ETFs can be grouped into two main categories, where the dominant category studies the dynamics of the U.S. market and of other major ETF markets. The smaller category studies the dynamics of emerging ETF markets, such as China, India, Taiwan and South Africa. As the markets of the two categories are widely different, the findings of the studies tend to differ as well.

Due to the comparatively insignificant size of the non-exotic Nordic ETF market, there exists very limited research with this geographical scope. However, the Nordic market exhibits unique characteristics that makes it a mix between the developed and the emerging ETF markets. In terms of age and size the Nordic ETF market is similar to markets like China, India, Taiwan and South Africa (Charteris 2013; Lin et al 2006; Chu 2011; Purohit & Malhotra 2015). However, when it comes to the macroeconomic environment, the Nordic market is more similar to the developed ETF markets. Thus, by studying the performance and market efficiency of the Nordic ETF market, we can contribute to the understanding of the dynamics of both Nordic ETFs and of ETFs in general.

With the aim of gaining extensive insight into the behaviour of the Nordic ETF market, we conduct the following types of analysis:

i. We analyse ETF performance by looking at the behaviour of NAV and price separately. Pricing and tracking efficiency are both key criterions for investors and have implications for their investment decisions (Charupat & Miu 2013a). However, as they are influenced by different factors, a separation of the two allows for a more detailed analysis.

ii. We compare the behaviour of bull, bear and traditional ETFs. By doing so, we aim to increase investor awareness regarding the differences and similarities between the three types of ETF.

iii. We compare our results with the findings of existing research. By doing so, we can conclude how Nordic ETFs differ from or behave similarly to ETFs in other markets.

As a result of the unique characteristics of the Nordic ETF market, we expect results that are both in line with and that differs from the findings of existing research. Since the Nordic market has a relatively stable economy and the majority of ETFs track the major Nordic indices, such as OMXS30 and OBX, we expect to find that the Nordic ETFs have high tracking efficiency. Furthermore, given that none of the Nordics ETFs follow international indices and since equity is relatively liquid compare to other types of asset classes, we expect to find small mispricings and that arbitrage opportunities quickly disappear. However, as the Nordic ETF market is significantly younger and smaller than the developed ETF markets, it is likely that the tracking and pricing efficiency of the Nordic market does not reach the same levels.

3.2 Methodology

In order to examine the performance of the Nordic ETF market, we have divided our analysis into three parts. First, we measure the overall performance of the ETFs. This is done by outlining the annual over-/underperformance without regards to the multiples, followed by an OLS regression analysis where the multiples are in focus. Second, we examine the magnitude of tracking error and price deviation. Third, we examine potential explanatory factors of tracking error and price deviation. Due to the effect of the leverage ratio on the return of the ETF, separate regressions are made for each group of ETFs: traditional ETFs, bull 1.5, bull 2, bear 1.5 and bear 2. While traditional ETFs have a multiple of 1, bull (bear) ETFs have a positive (negative) multiple. The magnitude of the multiple is specified in the group name.

3.2.1 Measuring Performance

3.2.1.1 Annual Return

To examine whether it is profitable to hold Nordic ETFs compared to holding the respective benchmarks, we conduct an analysis of the annual ETF returns in relation to the annual benchmark returns. The analysis studies the raw performance of the ETFs without considering if the returns deviate from the leverage multiples and if the ETFs live up to their stated objectives.

The annual returns are computed by compounding daily returns. As suggested by Rompotis (2011), the analysis is conducted with two different measures of ETF return. The first measure is the daily rate of change in net asset value of the fund, calculated in percentage as follows:

$$R_{pt}{}^{1} = \frac{NAV_t - NAV_{t-1}}{NAV_{t-1}} * 100 \tag{1}$$

The second measure of ETF return is the daily rate of change in the price of the fund, calculated in percentage by the following equation:

$$R_{pt}{}^{2} = \frac{P_t - P_{t-1}}{P_{t-1}} * 100 \tag{2}$$

By using the two measures of return we take into consideration the effect of both NAV and price on total ETF performance. With the NAV return measure, we investigate the success of the ETF provider in delivering the promised return. With the price return measure, we perform the analysis from the investor's perspective by adding the influence of the stock market and the creation and redemption mechanism of the APs. In other words, NAV return measures what an investor could have earned from holding an ETF if it was sold at its' NAV while price return measures what an investor could have earned from holding an ETF if it was sold at its' market price.

3.2.1.2 Performance Regression

With a performance regression analysis, we study and compare the performance of the Nordic ETFs relative to their benchmarks and multiples. As the returns of leveraged ETFs are affected by the compounding effect and are prone to deviate from the leverage multiples in the long run, we run performance regressions where the investment horizon is taken into consideration. Two different holding periods are incorporated in the analysis: One day and one month. In this way we can investigate how the holding period effects the performance of the ETFs.

The daily and monthly NAV and price returns of the ETFs are regressed against the corresponding benchmark returns using OLS regressions with Newey-West standard errors. The regression model can be expressed as follows (Rompotis (2005)):

$$R_{pt} = \alpha_t + \beta R_{bt} + \varepsilon_t \tag{3}$$

where R_{pt} is the percentage return of the fund's portfolio and R_{bt} is the return of the benchmark. If the ETF perfectly tracks the performance of its benchmark, β will take the value of the ETF's promised multiple. Thus, β is expected to be close to 1 for a traditional ETF and close to -2 for a bear ETF with a multiple of two.

Following the OLS regression, we perform one-sample Student's T-tests to assess whether the coefficients are significantly different from the target multiples of the ETFs.

3.2.2 Measuring Tracking Error and Price Deviation

A number of possible measures of tracking error have been applied in previous research. Pope and Yadav (1994) identify three of the most common measures, which are further analysed by Chu (2011). Based on the analysis of Chu (2011), where the specific characteristics of the definitions are assessed, we choose to use a definition where tracking error on day *t* is the absolute difference in

NAV return between the ETF and its' benchmark. However, since the specified definition is costumed to traditional ETFs, we have followed Charupat and Miu (2011) and included the factor β to adjust for the leverage multiples. Thus, the average tracking error over *n* days is obtained through the following equation:

$$Tracking\ error_p = \frac{\sum_{t=1}^{n} \left| R_{pt}{}^{1} * \beta - R_{bt} \right|}{n} \tag{4}$$

where β is the leverage ratio of the ETF, $R_{pt}{}^{1}$ is the daily NAV return of the ETF and R_{bt} is the daily return of the corresponding benchmark. By including β in the definition, tracking error should be close to zero for all ETFs.

Due to the transient nature of price deviation, where any inefficiencies for traditional ETFs typically disappear within a day, it is defined differently than tracking error. Following the advice of Charupat and Miu (2011) and Elton et. al. (2002), we define price deviation as the percentage deviation of the fund's market price from its NAV. The average percentage price deviation over *n* days is calculated as:

$$Price\ deviation_p = \frac{\sum_{t=1}^{n} \frac{P_{pt} - NAV_{pt}}{NAV_{pt}} \times 100}{n} \tag{5}$$

where P_{pt} is the daily closing price of the ETF and NAV_{pt} is the net asset value of the fund at the same point in time.

By conducting one-sample Student's T-tests with the null hypothesis that the mean is equal to zero, we can conclude whether the tracking error and price deviation for the five groups of ETFs are significant.

In order to examine the behaviour of premiums/discounts in relation to the movements of the underlying benchmarks, we calculate the correlations between price deviations and benchmark returns. We then investigate this matter further by computing the average price deviation when the benchmark returns are negative and when they are positive. A Wilcoxon-Mann-Whitney test is done in order to examine whether there are significant differences between average price deviations of the ETFs in the "up" respective the "down" state of the underlying benchmark.

3.2.3 Analysing Determinants of Tracking Error and Price Deviation

In order to gain a deeper understanding of the occurrence of tracking error and price deviations for Nordic ETFs, we investigate which factors affect the magnitude of respective measure. The conducted regressions can be expressed as follows:

$$\begin{aligned} Tracking\ Error_p = \alpha &+ \beta_1 Fund\ Flow + \beta_2 Fund\ Size + \beta_3 lnAge \\ &+ \beta_4 Expense\ Ratio + \beta_5 Dividend\ Yield + \beta_6 Amihud\ Illiquidity \\ &+ \beta_7 Exposure\ Adjustments + \beta_8 LagTracking\ Error \\ &+ \beta_9 Benchmark\ Volatility + \beta_{10} Replication\ Dummy \\ &+ \beta_{11} Xact\ Dummy + \varepsilon_t \end{aligned} \quad (6)$$

$$\begin{aligned} Price\ Deviation_p = \alpha &+ \beta_1 Fund\ Flow + \beta_2 Spread + \beta_3 Fund\ Size + \beta_4 lnAge \\ &+ \beta_5 Expense\ Ratio + \beta_6 Dividend\ Yield + \beta_7 Amihud\ Illiquidity \\ &+ \beta_8 LagPrice\ Deviation + \beta_9 Benchmark\ Volatility \\ &+ \beta_{10} Replication\ Dummy + \beta_{11} Xact\ Dummy + \varepsilon_t \end{aligned} \quad (7)$$

In equation 7, price deviation is measured in an absolute scale, as the explanatory variables are expected to be connected to the magnitude of the deviation rather than the occurrence of discounts and premiums. The two regressions consist mainly of the same explanatory variables, but since some variables are specific in explaining either tracking error or price deviation they are only included in that specific regression. While the definitions of all explanatory variables can be found in Appendix 3, we discuss the explanatory variables that need clarification here in the methodology section:

In order to measure how the volatility of the underlying indices impacts the tracking and pricing efficiency of the Nordic ETFs, we use intraday volatility as a measure of the volatility of the indices, defined by Rompotis (2012) as the following:

$$Benchmark\ Volatility_{bt} = \frac{High\ price_{bt} - Low\ price_{bt}}{Last\ price_{bt}} * 100 \quad (8)$$

where $High\ price_{bt}$ is the highest price the ETF reached during the trading day t, $Low\ price_{bt}$ is the lowest price the ETF reached during day t, and $Last\ price_{bt}$ is the closing price of the ETF on day t. We express the measure in percentage terms.

Amidhud's illiquidity measure has been used in several studies as a proxy for illiquidity when examining the impact of liquidity on the performance of ETFs. We use the definition specified by Ackert and Tian (2008) expressed in percentage terms:

$$Amihud\ Illiquidity_{pt} = \sqrt{\frac{\left|R_{pt}{}^{2}\right|}{Trading\ volume_{pt}}} * 100 \tag{9}$$

Daily return, $R_{pt}{}^{2}$, is computed using closing prices and $Trading\ volume_{pt}$ is defined as the total SEK value of the ETFs traded during the day.

Bid-ask spread is another indicator of the liquidity of the ETF. A common definition of spread is defined by Roll (1984) as follows:

$$Spread_{pt} = \frac{Bid\ price_{pt} - Ask\ price_{pt}}{\sqrt{Ask\ price_{pt} * Bid\ price_{pt}}} * 100 \tag{10}$$

where $Bid\ price_{pt}$ is defined as the highest price an investor will accept to pay for a security and $Ask\ price_{pt}$ is defined as the lowest price a dealer will accept to sell a security for.

To estimate the impact of the daily rebalancing and compounding effect on tracking efficiency, we use the following estimate as a proxy for the daily amount of adjustment of the ETF's portfolio p on day t (Cheng & Madhavan 2009):

$$Exposure\ Adjustments_{pt} = (\beta^2 - \beta) * AUM_{t-1}^{p} * R_{bt} \tag{11}$$

where β is the leverage ratio, AUM_{t-1}^{p} is the ETF's assets under management on day t-1, and R_{bt} is the return of the fund's underlying index on day t.

4 Data Description

4.1 Sample

We define a Nordic ETF as an ETF listed in Sweden, Norway, Finland, Denmark or Iceland and that is issued by an ETF provider from the same region. All ETFs in our sample have exposure to the Nordic market by following Nordic benchmarks. Due to differing characteristics of different underlying asset classes, we have decided to only include ETFs with equity as underlying asset class. We therefore exclude two Nordic ETFs in our sample, as they have commodity and corporate bonds as underlying asset classes. We are also forced to exclude the only ETF in Iceland due to lack of data. In total only three ETFs in the Nordic market have been excluded from the sample.

Table 1: Overview of Sample
The table outlines the names, main characteristics and underlying benchmarks of the ETFs. Market capitalization obtained from Bloomberg in MSEK.

Name	Multiple	Country	Benchmark	Issuer	Listing date	Market cap.	Management fee
Traditional ETFs							
DNB OBX	1	Norway	OBX TR	DNB	2005-03-04	1,203	0.30%
OMX Helsinki 25 ETF	1	Finland	OMXH25	Seligson & Co	2002-02-11	2,671	0.17%
SpotR OMXS30	1	Sweden	OMXS30GI	SEB	2011-03-16	150	0.20%
Xact OMXS30	1	Sweden	OMXS30GI	Xact	2000-10-30	10,634	0.10%
Xact Nordic 30	1	Sweden	VINX30	Xact	2006-05-04	9,104	0.15%
Xaxt High Div	1	Sweden	SHB NSB Index	Xact	2017-03-31	1,750	0.30%
Xact OMXSB Div	1	Sweden	OMXSB GI	Xact	2003-05-26	2,342	0.15%
Xact OBX	1	Norway	OBX TR	Xact	2017-09-15	1,866	0.30%
Xact Swedish Small Cap	1	Sweden	CSRXSE	Xact	2016-02-09	1,687	0.30%
Leveraged ETFs							
SpotR Bull OMXS30	2	Sweden	OMXS30GI	SEB	2011-03-16	30	0.50%
SpotR Bear OMXS30	-2	Sweden	OMXS30GI	SEB	2011-03-16	9	0.50%
Xact Bull	1.5	Sweden	OMXS30GI	Xact	2005-02-08	764	0.60%
Xaxt Bear	-1.5	Sweden	OMXS30GI	Xact	2005-02-08	552	0.60%
Xact Bull 2	2	Sweden	OMXS30GI	Xact	2009-11-06	531	0.60%
Xact Bear 2	-2	Sweden	OMXS30GI	Xact	2009-11-06	729	0.60%
Xact OBX Bull	2	Norway	OBX TR	Xact	2017-09-15	350	0.80%
Xact OBX Bear	-2	Norway	OBX TR	Xact	2017-09-15	608	0.80%

Our sample consists of 9 unleveraged and 8 leveraged ETFs, which are presented and described in Table 1. The majority of the funds are issued by Xact and listed in Sweden. Four ETFs are listed in Norway and one ETF is listed in Finland. Since ETFs are relatively new instruments, many of the Nordic ETFs were issued during the past ten years. The timespan of our analysis is from 2012-01-01 until 2018-04-04, which gives us a good amount and quality of data. The ETFs that were issued after 2012 are included in the sample from the date of their issue.

The majority of our data is retrieved from Bloomberg at the Swedish House of Finance on 2018-04-04. In the case of missing data in Bloomberg, complementary data has been retrieved from Thomson Reuters Eikon. Additional data, such as replication strategy has been retrieved from the fund issuers' websites.

4.2 Potential Biases

4.2.1 Missing Values and Outliers

As the exchanges are closed on weekends and public holidays, stock market data often contains missing values. The most common approach for dealing with missing values is the listwise deletion method, which is deleting the missing values from the sample. However, this method can generate biased estimates if the data is not completely missing at random, MCAR (Allison 2002). We conducted the Little's test of missing completely at random and found that our data is not MCAR at a 0.1% significance level (Li 2013). This result is expected when looking at stock data, since the missing values of one variable is related to the missing values of the other variables, for instance due to public holidays. Nevertheless, many researchers still use the listwise deletion approach (if the number of missing values is not too large), although their data is not MCAR (Mehmetoglu & Jakobsen 2017, p. 339). We have therefore concluded to use the listwise deletion approach but are aware of a possible bias.

Wooldridge (2013) brings up the potential effect of outliers on OLS estimates. Since large residuals receive a large weight in the least squares minimization problem, they could have a substantial influence over the OLS estimates. However, this influence decreases with sample size and is in our case therefore expected to be small. Looking at our data, one clear outlier can be observed for the closing price of one ETF. We examine the influence of the outlier by observing any difference on the OLS estimates when the observation is removed, and we find that there is no difference in the regression results. However, in the case of this particular observation, we choose to exclude it from the data set despite its minimal influence. The reason for this is its large deviation from other price measures for the same day, such as mid-price. The observation can therefore not be considered representative for the price level of that day.

4.2.2 Heteroscedasticity and Autocorrelation

Time series data often suffers from heteroscedasticity and autocorrelation, which goes against the Gauss-Markov Theorem (Wooldridge 2013, p. 399). Autocorrelation occurs when there is a correlation in the error terms which leads to an inaccurate least square estimate. This results in biased estimates of the standard error terms and may lead to false positive findings (Mehmetoglu & Jakobsen 2017, p. 231). In order to test for autocorrelation of panel data, we use the test of Drukker (2003). The results indicate that some of our data suffer from autocorrelation. Furthermore, autocorrelation can cause heteroscedasticity, which occurs when there is a correlation between the error term and the explanatory variables. To assess whether our data suffers from heteroscedasticity we conduct the Breush-Pagan/Cook-Weisberg test, where we find that our data suffers from heteroscedasticity at significance level of 0.1% (Breush & Pagan 1979; Cook & Weisberg 1983). To correct for both autocorrelation and heteroscedasticity we use Newey-West standard errors in the OLS regressions (Newey & West 1987).

5 Empirical Results and Analysis

5.1 Measuring Performance

5.1.1 Annual Return

In Table 2, the annual NAV returns of the five types of Nordic ETFs are presented for the years 2012 to 2018. The data for 2018 reaches until early April, so only the first quarter of the year is represented. Since three of the groups include several ETFs, annual return for the groups and for the benchmarks is calculated as an average of the aggregated returns. By subtracting the annual returns of the benchmarks from the annual returns of the ETFs, we get the annual under- or overperformance before management fees. As the corresponding benchmark of each ETF is either gross or net dividends depending on the dividend policy of the ETF, the annual under- or overperformance takes dividends into consideration.

From Table 2 we conclude that bull ETFs have outperformed the benchmarks in the long run by taking advantage of a generally bullish market. However, during 2015, when the average return of the benchmarks was only slightly positive (2.23%) the return of the bull ETFs was negative. This indicates that benchmark return needs to be strongly positive for it to be reflected in the return of bull ETFs.

The annual underperformance of bear ETFs emphasizes the speculative nature of the instrument. Although drastic market declines can lead to attractive returns, longer periods of moderate growth erode the long-term performance of bear ETFs. As a natural result of the leverage ratios, the ETFs with a multiple of -2 are shown to have a lower annual return than the ETFs with a multiple of -1.5.

While traditional ETFs have annual returns close to the returns of the benchmarks, they systematically underperform their benchmarks by approximately 1 percentage points per year. When taking management fees into consideration, the underperformance is only marginally larger. The underperformance of Nordic traditional ETFs is thus larger than the 0.28 percentage points underperformance of the American SPDR examined by Elton et al. (2002).

If we compare the annual NAV and price returns, we see that they are similar for most years and ETFs. However, in some cases the difference is as large as 10 percentage points. The inconsistent difference between annual price return and annual NAV return could be a result of fluctuating levels of pricing efficiency. Even if pricing efficiency is generally high, occasional large price deviations could strongly affect the accumulated return.

Table 2: Annual Return

Annual NAV and price return of the five groups of ETFs and annual return of their benchmarks. The difference is the annual over- or underperformance calculated as the deviation of the ETF annual return from the annual benchmark return. Displayed in percentage terms. Return is computed from daily NAVs and prices as the average annual return of the ETFs included in a group.

	Traditional					Bull 1.5					Bull 2				
	Fund		Benchmark	Difference		Fund		Benchmark	Difference		Fund		Benchmark	Difference	
Year	NAV	Price		NAV	Price	NAV	Price		NAV	Price	NAV	Price		NAV	Price
2012	13.57	13.72	15.13	-1.56	-1.41	17.68	19.16	14.99	2.69	4.17	24.13	26.77	14.99	9.14	11.78
2013	24.14	24.78	25.15	-1.01	-0.37	37.30	36.92	25.46	11.83	11.46	51.31	48.09	25.46	25.84	22.63
2014	13.37	13.17	12.62	0.75	0.55	22.76	36.92	13.95	8.80	22.97	27.98	31.80	13.95	14.03	17.85
2015	2.22	4.18	4.78	-2.56	-0.60	-3.50	1.79	2.23	-5.74	-0.44	-3.17	0.39	2.23	-5.41	-1.84
2016	15.25	11.09	15.53	-0.28	-4.44	12.73	12.73	9.41	3.32	3.32	14.13	28.44	9.41	4.72	19.03
2017	9.28	8.60	10.22	-0.94	-1.62	10.27	9.71	7.66	2.61	2.05	12.55	5.56	7.15	5.40	-1.59
2018	1.06	0.52	0.46	0.60	0.06	-3.82	-5.79	-3.44	-0.38	-2.35	-2.54	-5.72	-0.87	-1.67	-4.85
Average	11.27	10.87	10.04	-0.71	-1.12	13.35	15.92	10.04	3.31	5.88	17.77	19.33	10.33	7.44	9.00

	Bear 1.5					Bear 2				
	Fund		Benchmark	Difference		Fund		Benchmark	Difference	
Year	NAV	Price		NAV	Price	NAV	Price		NAV	Price
2012	-20.40	-21.65	14.99	-35.39	-36.64	-28.49	-27.02	14.99	-43.48	-42.01
2013	-30.41	-29.32	25.46	-55.87	-54.78	-38.38	-37.77	25.46	-63.84	-63.23
2014	-21.96	-19.50	13.95	-35.91	-33.45	-27.62	-18.01	13.95	-41.57	-31.96
2015	-5.14	-10.74	2.23	-7.37	-12.97	-11.92	-16.46	2.23	-14.15	-18.69
2016	-21.50	-21.59	9.41	-30.91	-31.00	-28.31	-32.94	9.41	-37.72	-42.35
2017	-13.32	-12.79	7.66	-20.99	-20.45	-15.97	-17.28	7.15	-23.12	-24.43
2018	1.66	3.80	-3.44	5.10	7.24	3.90	8.45	-0.87	4.77	9.32
Average	-15.87	-15.97	10.04	-25.91	-26.01	-20.97	-20.15	10.33	-31.30	-30.48

5.1.2 Performance Regression

The regressions presented in Table 3 and 4 show the performance of the ETFs relative to their corresponding benchmarks. If an ETFs would follow its benchmark and multiple perfectly, beta would be equal to the multiple and alpha would be equal to zero. However, as the tables show, the betas and alphas tend to deviate slightly from their target values. The regression results also indicate that there are differences in performance between traditional, bull and bear ETFs, as well as between return measures.

In Table 3, where ETF return is measured with NAV, all coefficients are close to their stated multiple for the holding period of one day. Only the coefficient of bear 2 ETFs is significantly different from zero, which means that they do not perform according to the multiple. While some alphas are statistically significant, they are still very close to zero. For the holding period of one month, the coefficients of bull 2 and bear 1.5 are still very close to the multiples. However, in the case of bull 1.5 and bear 2, the tracking ability decreases. Thus, we conclude that the performance of Nordic leveraged ETFs differs considerably between funds. While two of the groups can provide the promised performance on a monthly basis, the other two cannot. One group also has difficulty tracking the underlying benchmarks on a daily basis.

An important aspect when interpreting the regression results is the impact of sample size on statistical significance. Note that in the case of bear 2 ETFs, the significance levels for the holding period of one day are higher than those of one month – despite a smaller deviation. This is a result of the positive relationship between sample size and statistical power. Since the sample size of the holding period of one day is larger than the sample size of the holding period of one month, smaller absolute differences have greater impact on the p-value. Here we apply the concepts of statistical and economic significance. They explain that while small deviations may have a statistical significance, they may not have an economic impact.

From the regressions in Table 3, we see that bull ETFs tend to have a coefficient that is larger than the multiple. The opposite is true for bear ETFs, which tend to have a coefficient that is closer to zero than the multiple. We conclude that bull ETFs tend to outperform their multiple in the long run while bear ETFs tend to underperform. This underperformance of bear ETFs is consistent with the findings of Charupat and Miu (2011). Similar to the findings of Shum and Kang (2012), we find that bear 2 ETFs have a larger deviation from the target multiple than bull 2 ETFs as the holding period increases. However, this does not apply for leveraged ETFs with a multiple of 1.5 and -1.5.

Table 3: Performance Regression with NAV Return

Performance regression on ETF NAV return against benchmark return. Results are displayed according to ETF type and holding period. The regression is expressed as ${R_{pt}}^1 = \alpha_t + \beta R_{bt} + \varepsilon_t$. The table also displays the p-values from t-tests of whether betas are significantly different from their corresponding multiple and whether alphas are significantly different from zero.

	Traditional		Bull 1.5		Bull 2		Bear -1.5		Bear 2	
	1 Day	1 Month	1 Day	1 Month	1 Day	1 Month	1 Day	1 Month	1 Day	1 Month
Beta	1.0009	1.0012	1.5103	1.5523*	1.9918	2.0191	-1.5104	-1.4999	-1.9799**	-1.8987*
P-value	(0.2417)	(0.8616)	(0.2139)	(0.0191)	(0.1618)	(0.3698)	(0.2125)	(0.9972)	(0.0073)	(0.0130)
Std. Err.	[0.0008]	[0.0069]	[0.0083]	[0.0218]	[0.0058]	[0.0212]	[0.0083]	[0.0303]	[0.0075]	[0.0403]
Alpha	0.0000*	-0.0546*	-0.0000	-0.1816*	-0.0001**	-0.0025***	0.0000	-0.1406	0.0001	-0.2490*
P-value	(0.0204)	(0.0248)	(0.1484)	(0.0178)	(0.0083)	(0.0000)	(0.4280)	(0.2567)	(0.1314)	(0.0410)
Std. Err.	[0.0006]	[0.0243]	[0.0028]	[0.0749]	[0.0022]	[0.0592]	[0.0029]	[0.1230]	[0.0041]	[0.1209]
Observations	10158	505	1543	76	3243	160	1541	76	3241	160
Number of ETFs	9	9	1	1	3	3	1	1	3	3

Table 4: Performance Regression with Price Return

Performance regression on ETF price return against benchmark return. Results are displayed according to ETF type and holding period. The regression is expressed as ${R_{pt}}^2 = \alpha_t + \beta R_{bt} + \varepsilon_t$. The table also displays the p-values from t-tests of whether betas are significantly different from their corresponding leverage multiple and whether alphas are significantly different from zero.

	Traditional		Bull 1.5		Bull 2		Bear -1.5		Bear 2	
	1 Day	1 Month	1 Day	1 Month	1 Day	1 Month	1 Day	1 Month	1 Day	1 Month
Beta	0.9144***	0.9544*	1.4507***	1.5373*	1.8078***	1.9625	-1.4445***	-1.4732	-1.8030***	-1.7556**
P-value	(0.0000)	(0.0393)	(0.0000)	(0.0349)	(0.0000)	(0.5580)	(0.0000)	(0.1081)	(0.0000)	(0.0018)
Std. Err.	[0.0061]	[0.0220]	[0.0079]	[0.0173]	[0.0231]	[0.0639]	[0.0094]	[0.0165]	[0.0176]	[0.0771]
Alpha	0.0001	-0.0516	-0.0000	-0.1631***	0.0001	-0.1510	-0.0000	-0.1772*	-0.0000	-0.3000
P-value	(0.0503)	(0.3216)	(0.4267)	(0.0000)	(0.4379)	(0.4056)	(0.7537)	(0.0261)	(0.8624)	(0.2151)
Std. Err.	[0.0026]	[0.0520]	[0.0035]	[0.0359]	[0.0084]	[0.1811]	[0.0038]	[0.0781]	[0.0095]	[0.2410]
Observations	9575	505	1568	76	2938	160	1568	76	2942	160
Number of ETFs	9	9	1	1	3	3	1	1	3	3

* p<0.05, ** p<0.01, *** p<0.001

The results displayed in Table 4 indicate that there are larger deviations from the multiple when ETF return is measured with market prices. For a holding period of one day, the coefficients of all groups of ETFs are significantly different from the leverage multiples on a significance level of 0.1%. Thus, we conclude that pricing inefficiencies impact the return given to the investor. All coefficients are closer to zero than the multiples, which indicates that the market reactions do not fully correspond to the magnitude of changes in the NAV of the benchmark.

5.2 Measuring Tracking Error and Price Deviation

Table 5 shows that tracking error is statistically significantly different from zero at a 0.1% level for all groups of ETFs, indicating that Nordic ETFs do not replicate their underlying benchmarks perfectly. However, if we compare our results to the findings of other studies, we conclude that the average daily tracking error of traditional ETFs is lower in the Nordics than in other markets. With an average daily tracking error of 0.011%, the Nordic traditional ETFs track their indices better than the ETFs studied in Hong Kong, India, Turkey and the U.S. (Chu 2011; Purohit & Malhotra 2015; Baş & Sarıoğlu 2015; Shin and Soydemir 2010).

As Nordic ETFs track indices that are likely to be less volatile than the indices of the ETFs listed in India, Hong Kong and Turkey, it is not surprising that Nordic ETFs have a higher tracking ability. This is especially true since the indices of the Nordic ETFs are domestic while the indices of the ETFs in the other markets are both domestic and international. However, since research has found tracking error to decrease with fund size, fund age and fund and benchmark liquidity, it is surprising that Nordic ETFs have a higher tracking efficiency than U.S.-listed domestic ETFs. Since the daily tracking errors themselves are small, the difference is marginal and unlikely to have economic significance.

Due to a limited amount of published research on the subject, a similar comparative discussion cannot be had for leveraged ETFs. However, consistent to previous literature, we find that leveraged ETFs have higher tracking error than traditional ETFs. Furthermore, we find that the tracking error of leveraged ETFs has a higher standard deviation as well as a wider confidence interval than the tracking error of traditional ETFs, suggesting that there are larger deviations in tracking error for leveraged ETFs. This is also illustrated in the plots in Appendix 1 Figure 1-5.

Table 6 displays that price deviations are close to zero for traditional ETFs and the Nordic ETF market in general, which is consistent with the findings by Ackert and Tian (2000) and Elton et al. (2002). However, as price deviation can be both positive and negative, premium and discounts mostly balance out each other, resulting in a mean close to zero. From the plots in Appendix 1

Figure 6-10 and from the standard deviations in Table 6 it is clear that prices do deviate from the fund NAVs. In fact, the standard deviations are consistently larger for price deviation than for tracking error, indicating that the price movements may have an important influence over the return that an investor receives.

From Table 6 and Appendix 1 Figure 6-10 we can see that traditional ETFs have smaller standard deviations than leveraged ETFs, as well as a narrower confidence interval, implying that leveraged ETFs suffer from higher fluctuations in price. Leveraged ETFs also have a larger average price deviation. This could be partly due to that the creation and redemption process is more complicated for leverage ETFs, where there needs to be larger price deviations in order for the arbitrage mechanism to work (Charupat & Miu 2011). Consistent with the findings of Charupat and Miu (2011), we conclude that bull ETFs tend to trade at a discount (with a negative mean), whereas bear ETFs tend to trade at a premium (with a positive mean). The magnitude of the average premiums and discounts are close to the premiums and discounts of the Canadian and U.S.-listed leveraged ETFs studied by Charupat and Miu (2011 and 2013).

In Appendix 2, Table 9 displays the correlations between price deviations and benchmark returns for all individual ETFs. What we can see is that premiums are negatively correlated with benchmarks returns for bull and traditional ETFs, while premiums are positively correlated with benchmark returns for bear ETFs. This means that bear premiums are higher when benchmark returns are positive than when they are negative. Premiums of bull and traditional ETFs have the opposite pattern: Premiums are lower when benchmark returns are positive than when they are negative. The pattern is consistent with the findings of Charupat and Miu (2011). Consequently, as the benchmark return tend to be more positive than negative, the average price deviation of bull ETFs is negative while the average price deviation of bear ETFs is positive.

In Table 10 in Appendix 2, the average price deviations are divided into two groups: When the underlying benchmarks have positive returns and when they have negative returns. A Wilcoxon-Mann-Whitney test tells us that there are significant differences between the average price deviations of the ETFs in the two states of benchmark return. We can also see that only a few ETFs have an average price deviation that is positive or negative in both "states" of benchmark return. In most cases, the ETFs are interchangeably priced at a premium or discount depending on the benchmark returns.

A possible reason for the observed relationship is how trader behaviour change depending on the returns of the funds (Charupat & Miu 2011). To receive their profits, traders tend to want to sell their ETFs on days that the funds do well. For bull (bear) ETFs, this is when the benchmark return is positive (negative). If we consider bull ETFs on a day of positive benchmark return, the

Table 5: Tracking Error
The table reports the results of t-tests with the null hypothesis that the average daily tracking error and is equal to zero. Average tracking error is expressed in percentage terms. It is calculated as the sum of the absolute difference in daily return between the ETF and its benchmark, divided by the number of observations (see equation 4).

	All Funds	Traditional	Bull 1.5	Bull 2	Bear 1.5	Bear 2
Mean	0.0695***	0.0110***	0.1463***	0.1115***	0.1464***	0.1375***
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Std. Dev.	0.1517	0.0682	0.1426	0.1664	0.1427	0.2360
95% Conf. Interval	(0.0674, 0.7159)	(0.0097, 0.0124)	(0.1392, 0.1534)	(0.1057, 0.1172)	(0.1393, 0.1536)	(0.1293, 0.1456)
Observations	19,726	10,157	1,543	3,243	1,541	3,241
Number of ETFs	17	9	1	3	1	3

* p<0.05, ** p<0.01, *** p<0.001

Table 6: Price Deviation
The table reports the results of t-tests with the null hypothesis that the average daily price deviation is equal to zero. Average price deviation is expressed in percentage terms. It is calculated as the sum of the percentage deviation of the daily price of the ETF from the NAV of its benchmark, divided by the number of observations (see equation 5).

	All Funds	Traditional	Bull 1.5	Bull 2	Bear 1.5	Bear 2
Mean	0.0015	0.0013	-0.0055	-0.0280**	0.0250***	0.0231*
P-value	0.6184	0.6883	0.2252	0.0065	0.0000	0.0312
Std. Dev.	0.4126	0.3281	0.1804	0.5689	0.1892	0.5947
95% Conf. Interval	(-0.0044, 0.0073)	(-0.0052, 0.0078)	(-0.0145, 0.0034)	(-0.0481, -0.0078)	(0.0155, 0.0344)	(0.0021, 0.0442)
Observations	19,065	9,814	1,556	3,070	1,555	3,071
Number of ETFs	17	9	1	3	1	3

* p<0.05, ** p<0.01, *** p<0.001

closing transaction – which is used to measure daily price – is then likely to be initiated by a sell order. This will create a downward bias in the price of the transaction. As the opposite pattern exists for buyers of bull ETFs, this results in the correlations that we have observed.

5.3 Analysing Determinants of Tracking Error and Price Deviation

5.3.1 Tracking Error

As concluded in section 5.2, tracking error is comparatively small in the Nordic market. Due to the high tracking ability of the ETFs in our sample, we find that few variables explain tracking error in the regression of Table 7. Another aspect that impacts the results of the regression is the number of ETFs in our sample, where a smaller number leads to relationships that are increasingly difficult to detect. Therefore, it is not surprising with results that differ slightly from the findings of larger studies.

From the results displayed in Table 7, we identify two variables that have high explanatory power: Lagged tracking error and expense ratio. The coefficient of lagged tracking error is significantly different from zero at a 0.1% and 5% level among the groups (except for traditional ETFs) and shows that there is persistence in tracking error. This implies that today's tracking error is affected by the previous day's tracking error. Therefore, investors might want to look at the history of tracking error in order to assess the future tracking error. We also find that tracking error is positively correlated to expense ratio for leveraged ETFs and for all ETFs joined into one group. The observed relationship can be partly explained by leveraged ETFs having both higher expense ratio and higher tracking error.

We find that ETFs that use a physical replication method tend to have a slightly higher tracking error than ETFs that use a synthetic replication approach. Furthermore, benchmark volatility has a positive effect on tracking error for bear 2 ETFs at a 5% significance level. Even though the benchmark volatility is statistically significant at a 0.1% level for traditional ETFs, it is not economically significant given the low coefficient. Thus, in contrast to Qadan and Yagil (2012), we find no impact of benchmark volatility on the tracking error of traditional ETFs, which could be due to the similarity of the benchmarks in our sample.

Some variables in the regression produce insignificant and inconsistent results. Fund size is according to previous findings expected to be negatively related to tracking error due to economies of scale. However, since the coefficient is small and shifting between positive and negative values, we cannot draw a conclusion regarding its impact on tracking error. The same applies to fund age, dividend yield, fund flow, exposure adjustments and liquidity, as the factors either display inconsistent results or no economically significant impact on tracking error.

Given Xact's large market share in the Nordics, it is interesting to see whether the fund provider produce higher or lower tracking error. However, since the Xact dummy does not have a significant value, we conclude that the ETF provider has no clear impact on tracking error in the Nordic ETF market.

Table 7: Determinants of Tracking Error
The table displays the coefficient and p-value for each explanatory variable and ETF multiple. The results are also displayed for all ETFs as one group. Definitions of the explanatory variables are found in Appendix 3. Equation 6 specifies the regression model.

	All ETFs	Traditional	Bull 1.5	Bull 2	Bear 1.5	Bear 2
Fund Flow	0.0002	-0.0001	-0.0001	-0.0009	-0.0009	0.0002
	(0.2775)	(0.1688)	(0.9315)	(0.4164)	(0.5999)	(0.3109)
Fund Size	0.0251***	-0.0081***	-0.0239	0.0164**	0.0447	-0.0274***
	(0.0000)	(0.0001)	(0.3234)	(0.0066)	(0.1409)	(0.0000)
lnAge	-0.0113***	0.0018	-0.0794	0.0104***	0.0124	-0.0258***
	(0.0000)	(0.2926)	(0.1169)	(0.0001)	(0.7343)	(0.0000)
Expense Ratio	0.3290***	-0.0542		0.6411***		1.9320***
	(0.0000)	(0.2410)		(0.0000)		(0.0000)
Dividend Yield	0.0000***	0.0000	0.0000	0.0003*	-0.0001	0.0002
	(0.0001)	(0.3843)	(0.9562)	(0.0289)	(0.5063)	(0.3625)
Amihud Illiquidity	0.0009	0.0010	0.0399	0.0008	0.0281	0.0013
	(0.3992)	(0.4776)	(0.9080)	(0.6151)	(0.9613)	(0.2185)
Exposure Adjustments	0.0000***		0.0000	0.0000**	0.0000	0.0000***
	(0.0000)		(0.0934)	(0.0014)	(0.0736)	(0.0000)
Lag Tracking Error	0.2961***	0.1467	0.2939***	0.2684***	0.2816***	0.1217*
	(0.0000)	(0.0903)	(0.0000)	(0.0000)	(0.0000)	(0.0343)
Benchmark Volatility	-0.0000	0.0000***	0.0132	0.0089	0.0009	0.0145*
	(0.6751)	(0.0001)	(0.1761)	(0.1524)	(0.9444)	(0.0238)
Replication Dummy	-0.0116*	-0.0188***				
	(0.0471)	(0.0000)				
Xact Dummy	-0.0089					
	(0.1039)					
Alpha	-0.1561***	0.0708*	0.8738	-0.4805***	-0.3166	-0.6717***
	(0.0000)	(0.0397)	(0.1145)	(0.0000)	(0.4882)	(0.0000)
Observations	16060	7272	1528	2887	1508	2865

5.3.2 Price Deviation

The explanatory factors of price deviation in the Nordic ETF market are presented in Table 8. In contrast to the results of the tracking error regression, we find several variables with high explanatory power. Furthermore, many of our findings are consistent with previous literature.

In Table 8 we see that the spread variable has significant coefficients for several groups of ETFs. This indicates that an increase in bid-ask spread leads to higher price deviation. For instance, a 1% increase in spread leads to a 1.65 basis points increase in price deviation if we look at the group that consists of all ETFs. In accordance with the significance of bid-ask spread, we find Amihud's illiquidity measure to have a significant positive correlation to price deviation for all, bull 2 and bear 2 ETFs. We can therefore conclude that ETFs that are more liquid experience lower price deviations, which is consistent with the findings of Ackert and Tian (2008). Another result that is consistent with Ackert and Tian (2008) is the effect of fund size on price deviation. We find fund size to be negatively correlated to price deviation for all groups except for bear 1.5, implying that larger funds have lower price deviations as a result of stronger arbitrary forces.

Lagged price deviation has significantly positive coefficients for three of the six groups, indicating that price deviation is persistent for some of the ETFs. This finding is partly inconsistent with the studies of Elton et al. (2002) and Ackert and Tian (2000), which conclude that price deviations mostly disappear within a day. As for the effect of benchmark volatility, the groups of traditional and all ETFs do not have economically significant coefficients. However, leveraged ETFs have economically significant values at 0.1% level, indicating that an increase in volatility has a positive impact on price deviation. This indicates that the market reacts with some delay to large changes in fund NAV. Since any volatility in the underlying benchmark is amplified by the NAV movements of leveraged ETFs, it is not surprising that the relationship between benchmark volatility and price deviation is more apparent for leveraged ETFs than for traditional ETFs.

Fund flow, which serves as a measure of the intensity of the creation and redemption process, has significant values for bull 2 and bear 2 ETFs, as well as for the group with all ETFs. The negative coefficients imply that an increase in fund flow decreases price deviation. This means that the creation and redemption process fulfil its purpose of increasing pricing efficiency.

Similar to the findings of the tracking error regression, ETFs that use physical replication experience larger price deviations than ETFs that use a synthetic replication approach. Furthermore, since the Xact dummy is insignificant, the fund provider does not have a clear impact on price deviation.

Expense ratio has a strongly negative coefficient for bull 2 ETFs, which results in a large value of the corresponding coefficient for All ETFs. However, as the variable has no explanatory power for the other groups, we cannot draw a consistent conclusion regarding the impact of expense ratio on pricing efficiency. The same reasoning applies to fund age and dividend yield.

Table 8: Determinants of Price Deviation
The table displays the coefficient and p-value for each explanatory variable and ETF multiple. The results are also displayed for all ETFs as one group. Definitions of the explanatory variables are found in Appendix 3. Equation 7 specifies the regression model.

	All ETFs	Traditional	Bull 1.5	Bull 2	Bear 1.5	Bear 2
Fund Flow	-0.0013*	0.0012	0.0002	-0.0039*	-0.0010	-0.0016*
	(0.0467)	(0.4992)	(0.9021)	(0.0312)	(0.6245)	(0.0176)
Spread	0.0165***	0.0335***	0.0161*	0.0098	0.0621*	0.0048
	(0.0001)	(0.0000)	(0.0338)	(0.4379)	(0.0312)	(0.2723)
Fund Size	-0.1145***	-0.0475***	-0.0557**	-0.1330***	0.0113	-0.1545***
	(0.0000)	(0.0000)	(0.0077)	(0.0000)	(0.6990)	(0.0000)
lnAge	-0.0007	0.0004	-0.1179*	-0.0203	-0.0352	0.0131
	(0.7957)	(0.9535)	(0.0235)	(0.1046)	(0.3629)	(0.2152)
Expense Ratio	-0.3545***	-0.3903		-1.0536***		0.1948
	(0.0000)	(0.0683)		(0.0000)		(0.3103)
Dividend Yield	-0.0002***	-0.0001**	-0.0001	0.0001	0.0002*	-0.0001
	(0.0000)	(0.0080)	(0.6956)	(0.6809)	(0.0474)	(0.4176)
Amihud Illiquidity	0.0633***	0.0305	-0.4601	0.0859*	0.1382	0.0619*
	(0.0004)	(0.0936)	(0.1532)	(0.0286)	(0.7335)	(0.0386)
Lag Price Deviation	0.1855***	0.2049***	0.0221	0.0590	0.0331	0.1239***
	(0.0000)	(0.0000)	(0.4688)	(0.1590)	(0.4283)	(0.0000)
Benchmark Volatility	0.0000*	0.0000**	0.0410***	0.1343***	0.0394***	0.0835***
	(0.0121)	(0.0100)	(0.0001)	(0.0000)	(0.0000)	(0.0000)
Replication Dummy	-0.0945***	-0.0249				
	(0.0000)	(0.1735)				
Xact Dummy	0.0271					
	(0.0845)					
Alpha	1.1718***	0.6090***	1.4084*	1.6744***	0.2824	0.8351***
	(0.0000)	(0.0001)	(0.0118)	(0.0000)	(0.5634)	(0.0000)
Observations	15883	7202	1540	2801	1520	2820

6 Discussion and Critical Reflections

6.1 Limitation of Research

6.1.1 Sample Size

Due to the delimitation of the Nordic ETF market, we have a relatively small sample of ETFs. However, as we have covered almost the entire market (with exception of 3 ETFs) in our study, we are able to draw conclusion regarding the Nordic market as whole.

As the statistical tests and regressions in our study are conducted with regards to leverage multiples and holding periods, we have groups of data with differing sample size. The difference in sample size impacts the significance level of our t-tests. A large sample often results in statistical significance, since standard errors are small in relation to the coefficient estimates. We therefore take economic significance into consideration in addition to statistical significance, since too much focus on statistical significance can lead to false conclusions. As we have a large sample of traditional ETFs in contrast to the other groups, we look at the magnitude of the coefficient in addition to its p-value. While statistical significance is determined solely by the size of the t-statistic, economic significance is related to the size and sign of the estimate (Woolridge 2013, p. 127-128).

6.1.2 Price Measure

In equation 5, when calculating price deviation, we use closing prices, which is in line with the approach of Elton et al. (2002) and Charupat and Miu (2011). However, Engle and Sarkar (2006) highlight the issues that occur from measuring prices at the end of the day and conclude that it could be more accurate to use mid-quote prices, which is the difference between the average closing ask and bid prices. This is especially true if the fund is illiquid since the last transaction could have happened earlier during the day and therefore does not incorporate information regarding the end of day value of the ETF. It could also be misleading to use closing price since the last transaction might be above or below the closing mid-quote price depending on whether the last transaction is a sell or buy order. However, since we could not find data on closing bid and ask prices, using mid-quote prices was not possible in this study.

6.2 Robustness Checks

Since we find the traditional ETFs in the Nordic market to have a high tracking efficiency compared to other markets, we use another measure of tracking error in order to test the accuracy of our conclusion. The tracking error measure by Soydemir and Shin (2012) is defined as the standard errors of the residuals in equation 3. By comparing our results with the results of Soydemir and Shin (2012), we once again find that the tracking error of Nordic ETFs is smaller in magnitude than the tracking error of U.S.-listed ETFs.

To check the robustness of our regression models on the determinants of tracking error (see equation 6 and Table 7) and price deviation (see equation 7 and Table 8), we repeat our regressions with Huber-White standard errors instead of Newey-West standard errors (Huber 1967; White 1980; Newey & West 1987). In the regression on determinants of tracking error we find that even though the significance level changes for some coefficients, our conclusions remain the same regarding which factors have explanatory power of tracking error. However, in the regression on the determinants of price deviation, the changes of significance levels do have impact on our conclusions. We find that the impact of fund flow and replication strategy on price deviation is smaller than with the Newey-West standard errors. We also find that price deviation is more persistent. However, the impact of liquidly, fund size and volatility on price deviation is consistent with our previous findings.

7 Conclusion and Implications for Further Research

In this paper we conduct an extensive analysis of the performance and efficiency of the Nordic ETF market by examining returns as well as magnitudes and determinants of tracking error and price deviation. The sample consists of 17 ETFs, both unleveraged and leveraged, during the period of 2012-01-01 to 2018-04-04.

By computing the annual return of the ETFs and the annual return of their corresponding benchmarks, we measure the historical returns and obtain the over- or underperformance of the ETFs relative to their benchmark. The results show that traditional ETFs underperform their benchmarks by approximately 1% annually. Due to positive annual benchmarks returns, holding a bear ETF has generally generated negative annual returns. The opposite is true for bull ETFs, which have outperformed their benchmarks by approximately 5% per year when NAV return is used. The larger the multiple the more distinct is the observed relationship. Thus, a long position in the market has in recent years been the more attractive strategy, and it is clear that bear ETFs are solely suited for speculation or hedging.

When analysing tracking error, we find that traditional ETFs have an average tracking error of approximately 0.01%, which indicates that they have a higher tracking efficiency than the markets investigated in previous studies. Given that the Nordic market is stable and that the ETFs mainly follow large domestic indices, low deviations of NAVs from the underlying benchmarks are expected. Despite that the Nordic ETF market is both younger and smaller in size than the U.S. market, the tracking efficiency is higher. This indicates that some of the factors that previous research has found to have high explanatory power of tracking error are not relevant across markets. Similarly, we find price inefficiencies to be small on average and that the magnitude is smaller than in other markets. However, larger premiums and discounts occasionally do occur.

Due to a lack of existing research, we cannot conclude whether Nordic leveraged ETFs are better or worse trackers than leveraged ETFs in other markets. However, we find that leveraged ETFs have higher tracking error than traditional ETFs, which is consistent with existing research. We also find that the long-term tracking ability of leveraged ETFs differs between funds. While the return of bear 2 ETFs deviates from the multiple already when the holding period is one day, the returns of bear 1.5 and bull 2 ETFs continue to stay close to the multiples when the holding period is one month.

Similar to tracking error, the average price deviation is shown to be larger for leveraged ETFs than for traditional ETFs. While bull ETFs tend to trade at a small discount, bear ETFs tend to trade at a premium. This can be explained by the trading behaviour of the investors. When the underlying benchmark return is positive (negative), bull ETFs trade at discount (premium). The opposite relationship exists for bear ETFs. Therefore, given that the benchmark return is positive more days than it is negative, this leads to a negative (positive) average premium for bull (bear) ETFs.

When investigating factors that may be connected to tracking error and price deviation, we find that both tracking error and price deviation are persistent. We also find that the level of price deviation decreases with fund size, fund liquidity and fund flow and, in the case of leveraged ETFs, increases with benchmark volatility. Since a larger fund leads to lower transaction costs and economies of scale and fund flow activity has the purpose of correcting mispricing, the observed relationships are expected. Perhaps due to the generally small tracking errors, expense ratio is the only factor that is found to significantly explain tracking error.

Our findings have several implications for investors. Firstly, given the exceptionally high tracking efficiency of Nordic traditional ETFs, investors can expect the funds to closely replicate the underlying indices. Secondly, even though the Nordic ETFs are priced relatively efficiently, larger price fluctuations tend to occur throughout the day which could affect the final return given to an investor. Using ETFs as a passive investment form thus pose a slightly increased risk compared to using unlisted instruments, such as mutual funds. Based on the findings of the explanatory factors, we advise investors to evaluate management fees, fund size and liquidity and the risk levels of the benchmark before investing. Furthermore, given that the performance of leveraged ETFs differs substantially between funds, it could be beneficial to compare the funds before investing.

As ETFs are continuing their global expansion, we believe that the investment form will be a popular subject for future research. While we have studied how the ETFs are affected by different management and market factors, it will become increasingly relevant to study how ETFs affect the behaviour of the market. Furthermore, it would be interesting to investigate why ETFs aren't experience the same level of popularity in the Nordics as in the U.S. Based on our findings, we also believe that it is relevant to investigate how the tracking ability of leveraged ETFs affects their ability to function as hedging instruments. Another possible issue to study is how the emergence of leveraged ETF are influencing hedging behaviour of retail and institutional investors.

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9 Appendices

Appendix 1: Plots of Tracking Error and Price Deviation Expressed in Percentage Terms

Figure 1
Daily tracking error of traditional ETFs.

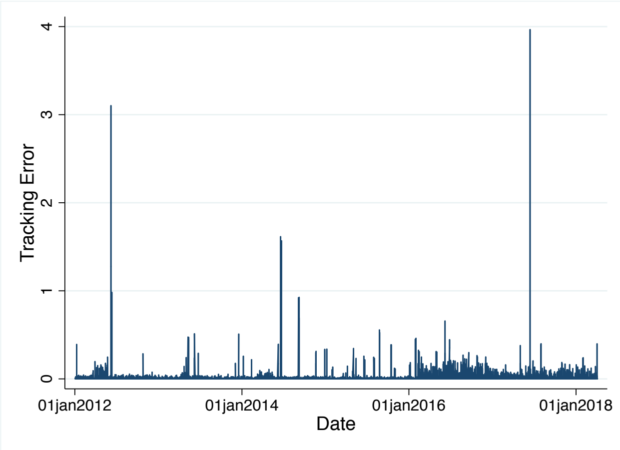


Figure 2
Daily tracking error of bull 1.5 ETFs.

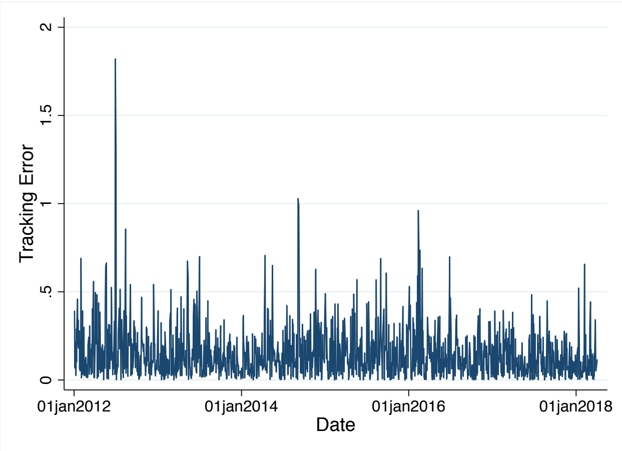


Figure 3
Daily tracking error of bull 2 ETFs.

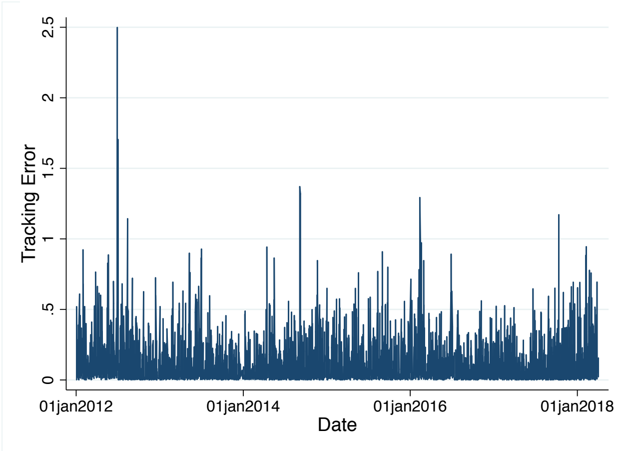


Figure 4
Daily tracking error of bear 1.5 ETFs.

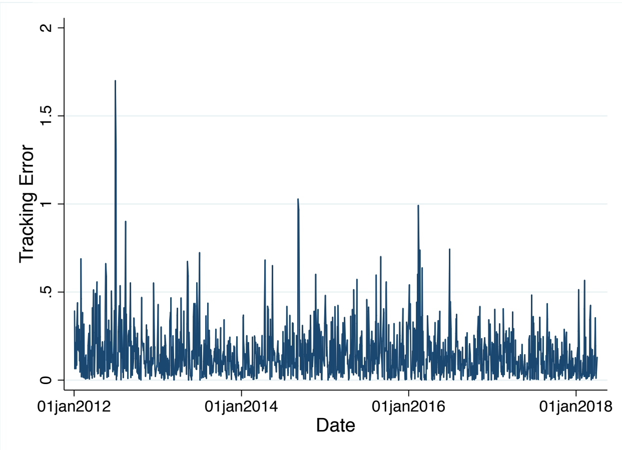


Figure 5
Daily tracking error of bear 2 ETFs.

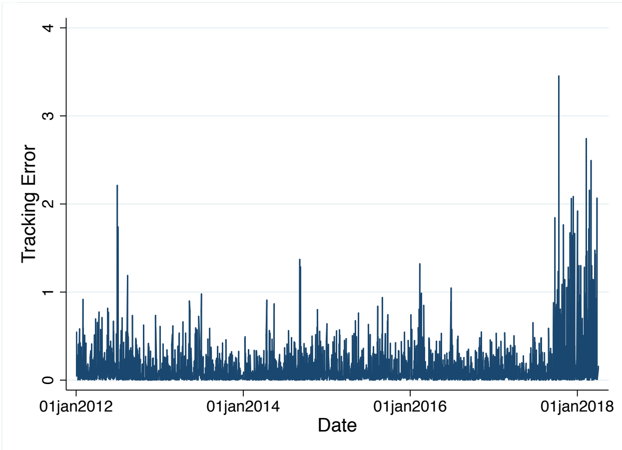


Figure 6
Daily price deviation of traditional ETFs

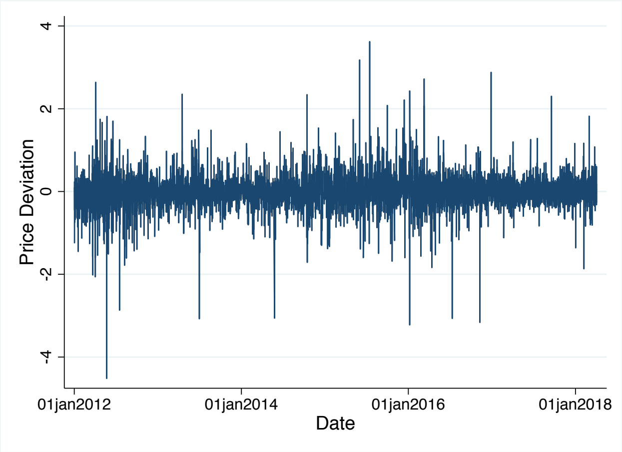


Figure 7
Daily price deviation of bull 1.5 ETFs

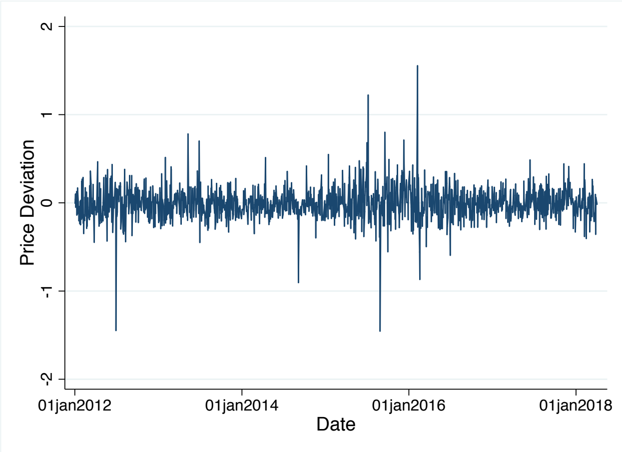


Figure 8
Daily price deviation of bull 2 ETFs

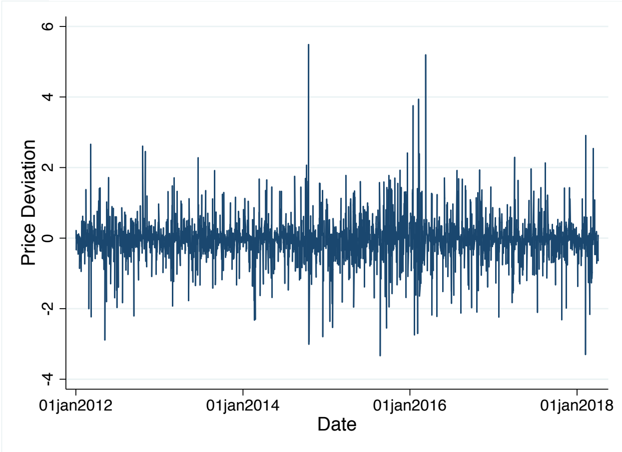


Figure 9
Daily price deviation of bear 1.5 ETFs

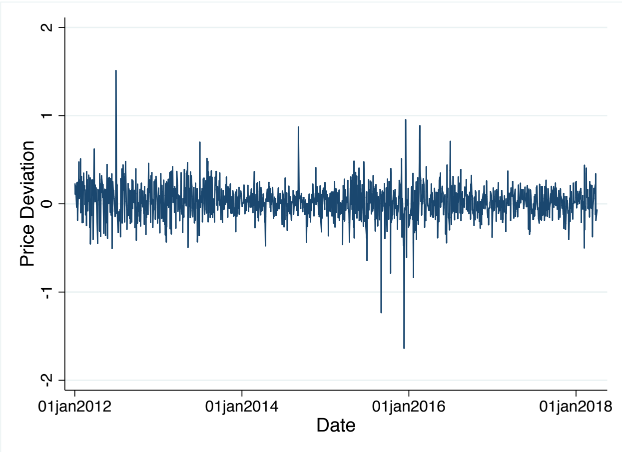
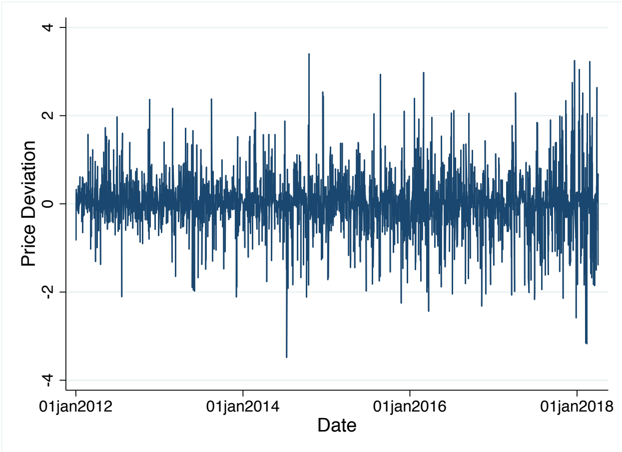


Figure 10
Daily price deviation of bear 2 ETFs



Appendix 2: Behaviour of Price Deviations with Regard to Benchmark Return

Table 9: Correlations Between Price Deviation and Benchmark Return
The table displays the correlations between the daily price deviations of the ETF and the underlying benchmark returns.

Traditional ETFs	
DNB OBX	-0.3363***
OMX Helsinki 25 ETF	-0.2130***
SpotR OMXS30	-0.3901***
Xact OMXS30	-0.2410***
Xact Nordic 30	-0.2569***
Xaxt High Div	-0.1772**
Xact OMXSB Div	-0.3534***
Xact OBX	-0.1200
Xact Swedish Small Cap	-0.1725***
Bull ETFs	
SpotR Bull OMXS30	-0.4245***
Xact Bull	-0.3273***
Xact Bull 2	-0.3450***
Xact OBX Bull	-0.3289***
Bear ETFs	
SpotR Bear OMXS30	0.3696***
Xaxt Bear	0.3159***
Xact Bear 2	0.3413***
Xact OBX Bear	0.3516***

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 10: Price Deviations Based on Benchmark Return
Average price deviation with regard to movements in the return of the underlying benchmark. The table displays the average daily price deviations of the ETFs when the underlying benchmarks has a positive return versus a negative return. A Wilcoxon-Mann-Whitney test confirms the difference in price deviations when the underlying benchmark increases versus decreases at a 0.1% significance level.

	Average price deviation when underlying benchmark increases	Average price deviation when underlying benchmark decreases
Traditional ETFs		
DNB OBX	-0.0007	0.0003
OMX Helsinki 25 ETF	-0.0005	0.0006
SpotR OMXS30	-0.0016	0.0015
Xact OMXS30	-0.0004	0.0003
Xact Nordic 30	-0.0008	0.0015
Xaxt High Div	0.0009	0.0012
Xact OMXSB Div	-0.0008	0.0010
Xact OBX	-0.0006	-0.0001
Xact Swedish Small Cap	0.0002	0.0008
Bull ETFs		
SpotR Bull OMXS30	-0.0033	0.0028
Xact Bull	-0.0005	0.0004
Xact Bull 2	-0.0006	0.0005
Xact OBX Bull	-0.0013	0.0001
Bear ETFs		
SpotR Bear OMXS30	0.0032	-0.0029
Xaxt Bear	0.0007	-0.0002
Xact Bear 2	0.0006	-0.0006
Xact OBX Bear	0.0016	0.0001
Observations	10269	8796

Appendix 3: Explanatory Variables of Tracking Error and Price Deviation

Fund Flow	Defined as the calculated net value of all creation and redemption activity of the ETF. It is expressed as a percentage of market capitalization, which is the current aggregated market value of the outstanding shares.
Spread	$= \frac{Bid\ price_{pt} - Ask\ price_{pt}}{\sqrt{Ask\ price_{pt} * Bid\ price_{pt}}} * 100$ $Bid\ price_{pt}$ is defined as the highest price an investor will accept to pay for a security and $Ask\ price_{pt}$ is defined as the lowest price a dealer will accept to sell a security for.
Fund Size	The total net assets of the fund, which equals the total amount of money invested in the fund.
lnAge	The natural logarithm of the age of the fund, which is expressed as days from the listing date of the ETF.
Expense Ratio	The annual percentage management fee as reported on the issuers' websites.
Dividend Yield	The dividend per share as a percentage of the share price. It excludes one-off dividends and is based on the anticipated annual dividend. The measure is retrieved from Thomson Reuters Eikon.
Amihud Illiquidity	$= \sqrt{\frac{\lvert {R_{pt}}^2 \rvert}{Trading\ volume_{pt}}} * 100$ ${R_{pt}}^2$ is daily return computed using closing prices. $Trading\ volume_{pt}$ is defined as the total SEK value of the ETFs traded during the day.
Exposure Adjustments	$= (\beta^2 - \beta) * AUM_{t-1}^{p} * R_{bt}$ β is the ETF leverage ratio, AUM_{t-1}^{p} is the ETF's assets under management on day t-1, and R_{bt} is the return of the fund's underlying index on day t.
Lag Tracking Error	The tracking error measure with a one-day lag.
Benchmark Volatility	$= \frac{High\ price_{bt} - Low\ price_{bt}}{Last\ price_{bt}} * 100$ $High\ price_{bt}$ is the highest price the ETF reached during the trading day t, $Low\ price_{bt}$ is the lowest price the ETF reached during day t, and $Last\ price_{bt}$ is the closing price of the ETF on day t.
Replication Dummy	Takes the value 1 for ETFs that use synthetic replication and the value 0 for ETFs that use physical replication. The measure indicates whether the choice of replication strategy of the ETFs is linked to the magnitude of tracking error/price deviation.
Xact Dummy	Takes the value 1 for ETFs issued by Xact and 0 for ETFs issued by other fund providers. The dummy indicates whether the magnitude of tracking error/price deviation is linked to the fund provider.