UNIVERSITY OF TURKU

ABSTRACT

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Author	Niini Halonen	Student number	509740
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Supervisors	Mika Vaihekoski, Valtteri Peltonen		

Abstract

Due to the abrupt growth of exchange-traded funds (ETF), academics and regulators have become increasingly interested on the effect that ETFs may have on the stock market. Several studies have found that ETFs may have a destabilizing effect on the shares that they hold. For instance, Ben-David et al. (2018) demonstrated, that ETFs add a new layer of trading in the underlying stock leading to increased volatility. However, nearly all studies on the subject have been made using data from the US market, which is a highly accessible and liquid market. Since the Nordic market has also experienced a significant growth in ETFs in recent years, I extended the study of Ben-David et al. (2018) to examine the effect that ETFs have on the underlying stock in the Nordics.

The results reached are in contrast to those of Ben-David et al. (2018). This study found that ETFs have decreased volatility in the underlying stock during years 2009-2018. No other variables were found that could have attributed to the decrease in volatility. In addition, ETFs have been found to add trading and liquidity in the underlying shares and have decreased return comovement and excess return. Overall, the Nordic market has seemed to benefit from the rise of ETFs through the improved efficiency that the ETFs have provided. However, it was found that the correlation between ETF ownership and daily stock volatility seems to be non-linear. This finding implies that as long as ETF ownership remains moderate, it has a positive impact on the underlying shares through decreased volatility but if the popularity of ETFs keeps rising, the effect may rotate. Based on the results reported by Ben-David et al. (2018), the US market has already surpassed this threshold where ETFs have started to impound non-fundamental liquidity shocks that are frequent enough to increase volatility. Even though the Nordic markets have so far benefitted from the increased competition among informed traders, regulators should be aware that the effect that ETFs currently have on the stock market may not be permanent and the effect that ETFs have on the US market would also enter the Nordic market.

Key words	ETF, exchange-traded funds, volatility, Nordic market
Further information	

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Tiivistelmä

Pörssinoteerattujen rahastojen eli ETF:ien äkillisen kasvun vuoksi akateemikot ja lainsäätäjät ovat yhä enemmän kiinnostuneet ETF:ien mahdollisista vaikutuksista osakemarkkinoihin. Useat tutkimukset ovat osoittaneet, että ETF-rahastoilla saattaa olla epävakauttava vaikutus osakkeisiin, joita rahastot omistavat. Muun muassa Ben-David ym. (2018) esittivät, että ETF:t luovat uuden kaupankäyntitason niiden omistamiin osakkeisiin, mikä johtaa volatiliteetin kasvuun kyseisissä osakkeissa. Lähes kaikki aiheesta tehdyt tutkimukset, on toteutettu käyttäen dataa Yhdysvaltojen markkinoilta, jotka ovat erittäin helposti saavutettavat ja likvidit markkinat. Myös pohjoismainen markkina on kokenut samankaltaista kehitystä ETF:ien saralla viime vuosien aikana, ja tästä johtuen laajennan Ben-David ym. (2018) tekemää tutkimusta käsittämään myös ETF:ien vaikutusta pohjoismaisiin osakkeisiin.

Tutkimukseni tulokset ovat lähes päinvastaiset Ben-David ym. (2018) saamiin tutkimustuloksiin nähden. Tulokset osoittavat, että ETF:t ovat vähentäneet volatiliteettia omistamissaan osakkeissa vuosien 2009-2018 aikana. Lisäksi tutkielma osoittaa, että ETF:t lisäävät kaupankäyntiä osakkeilla sekä parantavat likviditeettiä omistamissaan osakkeissa, ja ovat vähentäneet osakkeiden tuottojen korrelaatiota ja ylituottoa. Yleisesti ottaen pohjoismaiset markkinat näyttävät hyötyvän lisääntyneestä tehokkuudesta, jota ETF:t tarjoavat. Toisaalta, tutkimukseni osoittaa myös, ettei ETF:ien ja volatiliteein välinen korrelaatio ole lineaarinen. Tämä tarkoittaa, että niin kauan kun ETF:ien omistus osakkeissa pysyy kohtuullisena, niiden vaikutus osakkeisiin on positiivinen. Mikäli ETF:ien suosio kuitenkin vielä kasvaa vaikutus saattaa kääntyä päinvastaiseksi. Ben-David ym. (2018) antavat ymmärtää, että Yhdysvaltojen markkinat ovat jo ohittaneet tämän kynnysarvon, jossa epäfundamentaaliset likviditeettisokit ovat riittävän tiheitä, että sokit aiheuttavat volatiliteetin kasvua osakkeissa. Vaikka pohjoismaalainen markkina on tähän mennessä hyötynyt lisääntyneestä kilpailusta, lainsäätäjien tulisi olla tietoisia, että vaikutus joka ETF:llä on osakemarkkinoihin nykyisin ei välttämättä ole pysyvää, mikäli sama vaikutus kuin ETF:llä on Yhdysvalloissa saapuisi myös Suomeen.

Asiasanat	ETF, pörssinoteerattu rahasto, volatiliteetti, Pohjoismaiset markkinat
Muita tietoja	

UNIVERSITY OF TURKU
Turku School of Economics

IMPACT OF ETF OWNERSHIP ON SHARE VOLATILITY

Evidence from the Nordic markets

Master´s Thesis
in Accounting and Finance

Author:
Niini Halonen

Supervisors:
Prof. Mika Vaihekoski
M.Sc. Valtteri Peltonen

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The originality of this thesis has been checked in accordance with the University of Turku quality assurance system using the Turnitin OriginalityCheck service.

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1 INTRODUCTION

1.1 Motivation

The popularity of passive investing has risen from the growing recognition of its cost-efficiency and diversification benefits compared to active forms of investing. (Madhavan, 2016, 3-4.) Passive investing aims to track a specific market-weighted index or portfolio and the most common way to do this is by buying an index fund as the goal is to maximize profits by minimizing trading. Passive investing is growing at a rapid rate accounting for one third of all assets managed in the US. (Sullivan & Xiong, 2012.)

The innovation of exchange-traded funds (ETFs) has played a considerable role in driving the growth of passive investing in the past decade since most ETFs are passive index tracking funds. (Malamud, 2015.) An ETF is a marketable security that aims to replicate a chosen stock index, commodity, basket of assets or bonds rather than outperform it. Since ETFs are traded like stocks on an exchange, the price will change throughout the day. (Madhavan, 2016, 3-4.)

Exchange-traded funds were first introduced in the 1980s and have grown substantially in the recent decade in terms of size, diversity and market significance. (Madhavan, 2016, 3-4) In 2015, for the first time ever, assets under management of ETFs passed the amount of assets of hedge funds. In September 2018, the assets of exchange-traded products (ETPs) reached 5.2 trillion US dollars, a notable growth from 79 billion in year 2000, which implies a 26% compounded annual growth rate (BlackRock, Inc., 2018), double the growth rate that of actively managed assets (Sullivan & Xiong, 2012). The growth of global ETP assets from 2000 to September 2018 is presented in Figure 1. Equity based exchange-traded products (ETP) account for 80% of all ETPs in September 2018. The US is overwhelmingly the largest market for ETPs with assets of 3,713 billion USD followed by Europe with assets of 854 billion USD. (BlackRock, Inc., 2018.)

What makes ETFs distinctive and popular is that they allow investors to access the market continuously similarly to stocks, with high liquidity and with a low trading cost. In addition, ETFs are created through a unique process called creation and redemption, which is exclusively managed by liquidity providers called authorized participants (APs). These so-called APs have a dual role as they act as liquidity providers for the ETF market and as arbitrageurs between the securities and ETF market. In exchange for providing liquidity for the fund, APs have the right to perform arbitrage with ETFs and the underlying securities. However, the same reasons that make ETFs so distinctive may also attract more high-frequency demand than e.g. traditional index funds and may therefore have the capability to destabilize the market. (Ben-David et al., 2018.)

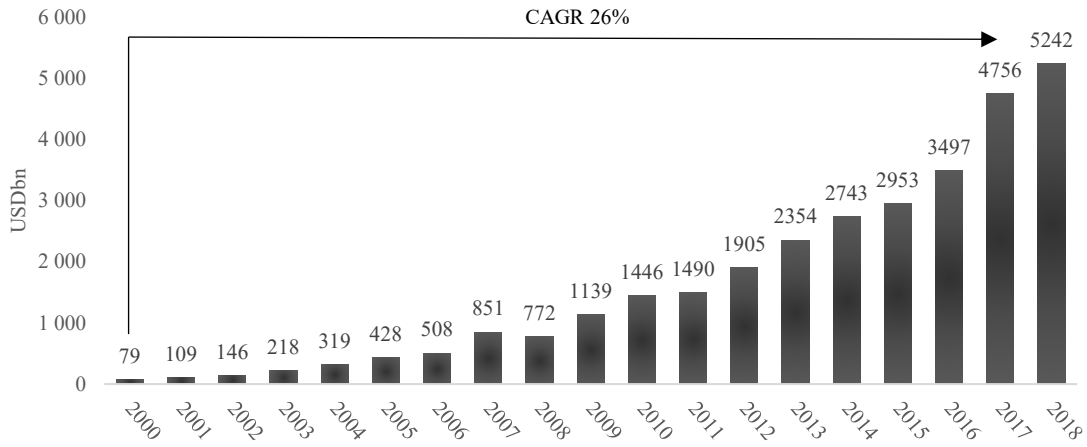

Figure 1 Global ETP assets (Adapted from BlackRock, Inc., 2018)

For example, active investing is a form of investing that aims to outperform the market, and therefore active investors have some discretion and control in which extent they trade and impact the price of the underlying security since they have the opportunity to choose in which asset, they want to invest in. (Da and Shive, 2015.) Trading with underlying securities of ETFs, on the other hand, is very mechanical and may therefore have a larger impact on the price of the underlying security. Since ETFs aim to replicate specific indices, there seem to be no discretion in the size, timing or composition of the trades of ETF arbitragers. As a result, ETFs may cause larger non-fundamental price shocks to the underlying assets than other funds. (Da and Shive, 2015.)

Researchers have discovered that US stocks have become more vulnerable in recent years to unanticipated events. Among other risk factors, systematic risk has risen over the last decades among large companies. Systematic risk was calculated as the cross-sectional average beta for every year in the sample period (1963-2008). (Kamara et al., 2010.) One possible reason for this trend is believed to come from the rise of passive asset management. Further, the growth of passively managed equity indices has been predicted to correspond to the rise in systematic market risk. (Sullivan & Xiong, 2012.)

ETFs play a key role in the passive investment trend and have the power to become a disruptive innovation for the current asset management industry. Several earlier studies (see, e.g. Anton & Polk, 2014; Leippold et al., 2016; Agarwal et al., 2018) have found that ETF ownership in shares may cause excess comovement in returns and commonality in liquidity in the underlying shares. Return comovement refers to positive correlation in stock returns among different securities (Barberis et al., 2002) and commonality in liquidity refers to an impact of a common or market wide liquidity factor on an individual share (Brockman et al., 2009). Therefore, ETFs may have the capability to destabilize the securities market and create a new risk structure. However, the existing literature focuses nearly only in the US market which is a highly accessible market and therefore the impact

of the rise of exchange-traded funds have in other markets is still widely unclear and complicated.

1.2 Objective of the study

Since the quantity, popularity and significance of ETFs has increased significantly over the past decade in the financial markets, it is important to understand the effects that ETFs may have on the share volatility and further on market risk. The goal of this study is to find if ETF ownership does increase daily volatility in the shares that the ETFs own (underlying stock) in the Nordics. The study is widely influenced by the study made by Ben-David et al. (2018) and this study is going to contribute to it by examining if the same results can be found in other markets than in the US. The theoretical framework is largely based on Greenwood's (2005) theory on the dynamics of arbitrage.

The main research question is:

- *How does ETF ownership affect the volatility of the underlying stock in the Nordic market?*

Based on previous studies made on the US market, the null hypothesis is that ETF ownership increases volatility in the underlying shares due to the unique arbitrage process between the ETFs and the underlying securities. The arbitrage process may cause non-fundamental liquidity shocks in the shares through non-fundamental liquidity shocks in the ETF. When these liquidity shocks are frequent enough, they may cause excess volatility in the shares. In sum, shares with higher ETF ownership should experience higher volatility.

However, the Nordic market is very different from the US market in terms of ownership structure, liquidity and size. Therefore, in order to further understand the overall implications that ETF have on market risk in the Nordic market, I will examine the relation between ETF ownership and other forms of equity market efficiencies and risk factors. The supporting research questions that I am going to address are:

- *How does ETF ownership affect*
  - *liquidity of the underlying stock?*
  - *return comovement of the underlying stock?*
  - *excess return of the underlying stock?*

The study concentrates on the Nordic markets using as data the stocks included in Nasdaq OMX Nordic 120 index from January 2009 to December 2018. Majority of the data is retrieved from Thomson Reuters Eikon database. The empirical study for the main

research question is going to conducted using regression analysis on ETF ownership and volatility while controlling for other factors, such as other forms of ownership, size and liquidity.

The discussion in the literary review is restricted to “ordinary” ETFs that only aim to replicate the benchmark index, and therefore excludes leveraged ETFs that use derivatives to track the performance of the benchmark.

1.3 Structure of the study

This study is based on a comprehensive literature review on the topic as well as an empirical study attempting introduce new knowledge to the academic community. The study proceeds as follows. Section 2 provides a theoretical framework on liquidity shock generation caused by arbitrage and is followed by earlier empirical studies made on the subject. Section 3 introduces the data collection, sample characteristics, and methodology. Section 4 provides the main findings of the empirical study, and finally, Section 5 concludes and summarizes, and gives suggestions for further research.

2 INSTITUTIONAL DETAILS AND THEORETICAL FRAMEWORK

The theoretical framework of this study is largely based on Greenwood's (2005) framework on the dynamics of asset prices in an unexpected event in which several assets simultaneously experience a non-fundamental liquidity shock. Ben-David et al. (2018) has contributed to the study by Greenwood (2005) by extending the framework to include ETFs and by providing two alternative hypotheses on why ETFs increase the volatility of the underlying stock. These hypotheses are liquidity trading hypothesis and price discovery hypothesis.

Liquidity trading hypothesis suggests that the volatility in the underlying shares is caused by noise traders that cause demand shocks in the secondary market that are propagated to the securities market through the arbitrage activity of authorized participants. Price discovery hypothesis on the other hand suggests that new information is first discovered in the ETF and the information will enter the prices of the underlying securities in a delay. ETFs therefore would improve price discovery. The shock is propagated through the same channel as in the liquidity trading hypothesis but instead of noise traders, shocks are caused by information traders. In these both cases volatility will spike because of ETFs but for different reasons.

2.1 Institutional details

2.1.1 Structure of ETFs

ETFs are investment funds that usually focus on holding securities of a particular asset class, industry, or geographical area. They resemble passive index funds but are listed on exchanges and are traded intraday by retail and institutional investors. ETFs were first introduced in the 1980s but started to gain more popularity in the 1990s. Since the turn of the century the number of ETFs has grown explosively and at one point in 2012, exchange-traded products accounted for 40% of all trading volume in the US securities markets. (Ben-David et al., 2018.) The structure of an exchange-traded fund is presented in Figure 2.

The structure of exchange-traded funds has qualities from both open-ended and closed-end funds. However, unlike in mutual funds, interaction between the fund and the investor does not automatically lead to creation or redemption of ETF shares. Investors trade directly with each other or alternatively with authorized participants (APs). If there is a net demand for ETFs, the AP will deliver a basket of securities to the ETF asset manager in

exchange for ETF creation units. Therefore, the flows of the fund and demand for ETF shares exerts pressure on the price of the underlying security. (Madhavan, 2016, 21.)

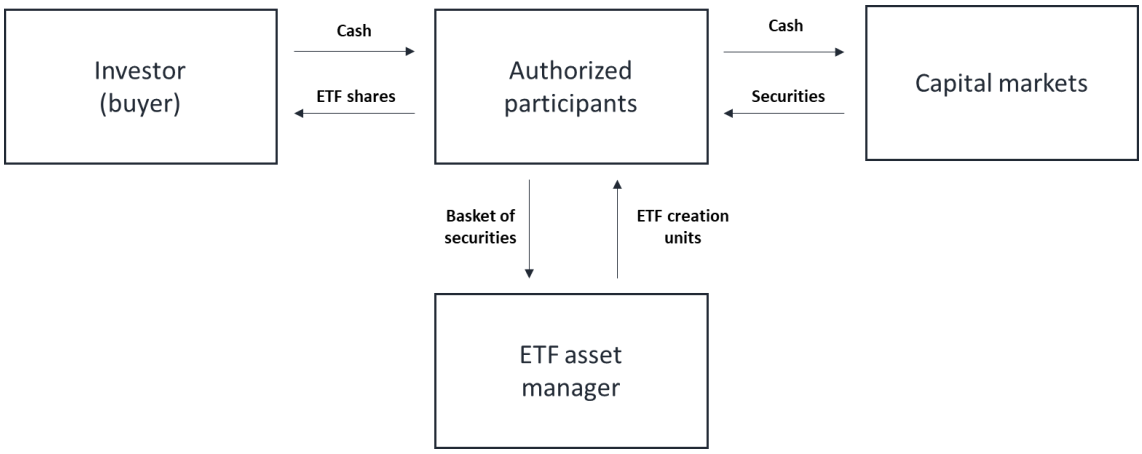

Figure 2 Structure of an exchange-traded fund (Adapted from Madhavan, 2016, 21)

APs are liquidity providers who can interact directly with the fund. APs are usually large financial institutions or specialized market makers. The asset managers of ETFs choose the APs in advance before creating a fund giving them exclusive rights to alter the number of ETFs outstanding through creation and redemption process. APs have a critical role in providing liquidity to the fund and linking the primary market of the underlying securities with the secondary market of ETF shares. Large exchange-traded funds have several APs whereas smaller niche funds may have only a few specialized authorized participants. APs do not receive compensation from the ETF asset manager nor is it legally required to create or redeem ETF shares. Usually, the compensation to the APs come from the market-making activities in the secondary markets through arbitrage.

As presented in Figure 2, ETF shares are created in a process called creation and redemption mechanism. The transaction allows for APs to exchange basket of securities or cash for ETF shares and vice versa with the ETF asset manager (see Figure 2, transaction between AP and ETF asset manager). Like regular investors APs can purchase and sell shares of ETFs in the secondary market (see Figure 2, transaction between AP and investor) but in addition, they can purchase and redeem shares directly from the ETF if there is a profit opportunity by purchasing ETFs from the investors and exchanging the ETF units with the asset manager to a basket of securities. This could be the case if the ETF was priced below net asset value.

Even though shares are redeemed and created at the end of the day, APs will lock in their profits intraday by selling the higher priced asset and buying the lower priced asset. The creation and redemption mechanism is based on arbitrage to keep the price of the ETF share as close as possible to the intrinsic value of the underlying securities. The

arbitrage mechanism also encourages the APs to provide liquidity when there is a demand for purchasing or selling ETF shares. The creation and redemptions mechanism serve two critical purposes. First, the creation and redemption mechanism offer an additional primary market to the AP and through that improves liquidity in the secondary market. Second, the mechanism ensures that the ETFs are traded at a price in line with the underlying net asset value (NAV). The AP can then exploit any deviations of the ETF price from NAV by taking opposite positions. (Malamud, 2015.) The mechanism of arbitrage will be explained more closely in the next section.

2.1.2 ETFs and the mechanism of arbitrage

ETFs have features from both closed- and open-ended funds yet still have some distinctive qualities. Like open-ended funds, ETFs can be created and redeemed at the end of the trading day at NAV. However, unlike open-ended funds, ETFs can be created and redeemed only by APs that have a legal contract and exclusivity to alter the number of ETFs outstanding. Like closed-end funds, ETFs are traded intraday on an exchange in the secondary market at a price that can diverge from NAV since the price of ETFs are determined by the demand and supply in the secondary market. Unlike closed-end funds, ETFs have the ability to force the price closer to NAV through the arbitrage mechanism. (Ben-David et al., 2018.)

ETF market can be divided into primary and secondary markets. Primary market is where the underlying shares are traded, and the secondary market is where ETFs are traded. Authorized Participants are liquidity providers who have a critical role in connecting the primary and secondary markets. APs have an exclusive capability to alter the number of ETFs outstanding through the creation and redemption process. Creation/redemption process is key to the price and tax efficiency. (Madhavan, 2016, 31-32.)

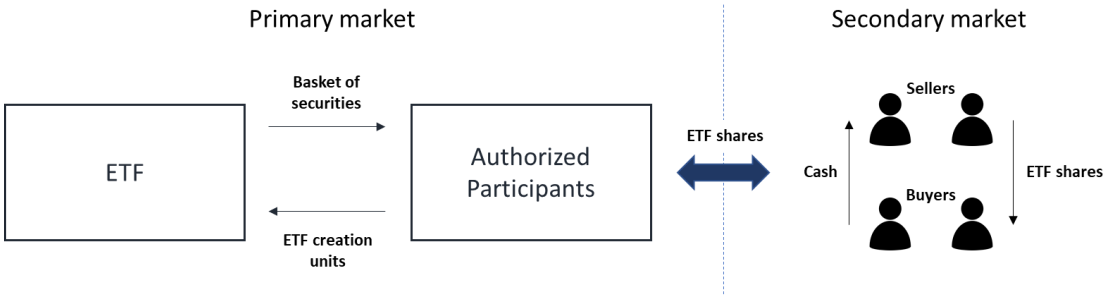

Figure 3 Creation of ETF shares (Adapted from Investment Company Institution, 2018)

Creation of ETFs are done by transferring the underlying securities of the ETF to the ETF asset manager. In exchange, the asset manager provides the AP with ETF creation units. (Ben-David et al., 2018.) The ETF creation process is presented in Figure 3. Creation unit consists of a number of ETF shares, usually between 25,000 to 250,000 shares. The value of a creation unit is based on the ETF's NAV at the end of the day that the creation was initiated. (Investment Company Institute, 2018.) Similarly, redemption is executed by AP receiving underlying securities in exchange for ETF units. These transactions made by APs constitute the primary markets for ETFs. (Ben-David et al., 2018.)

In order to demonstrate the process of arbitrage in the creation and redemption of ETFs, we provide two cases: ETF premium and ETF discount. When an ETF is prices above NAV, it is called premium, and if an ETF is priced below NAV, it is called discount. In the case of ETF premium, the APs will purchase the underlying shares, exchange them for ETF units and sell the ETFs on the secondary market. By increasing the number of ETFs in the secondary market and reducing the number of shares in the stock market, the AP will put downward pressure on the price of the ETF and upward price pressure on the NAV, reducing the premium. On the other hand, in the case of ETF discount, the APs will purchase ETF units on the secondary market, exchange them for securities and sell the securities in the primary market. This will put positive price pressure on the ETF and negative price pressure on the NAV, decreasing the discount. In rare cases, creation and redemption is done in cash. This happens generally when the underlying securities are illiquid or foreign. (Ben-David et al., 2018.)

Due to the unique arbitrage process of ETFs, premia and discounts between the ETF and NAV can be arbitraged away. Since this is not possible in closed-end funds, the magnitude of the divergence between fund price and NAV is smaller in ETFs. The arbitrage process also encourages APs to provide liquidity when ETFs are experiencing excess buying or selling demand. (Ben-David et al., 2018.)

Arbitrage can also be exploited by parties that are not Authorized Participants nor can undertake the creation and redemption process. Any investor can exploit the divergence between the price of the ETF and the underlying securities by purchasing the cheaper one and selling short the more expensive one. The investor then holds the position until the prices converge and then realize the profits from arbitrage. (Ben-David et al., 2018.)

ETF sponsors provide NAV values every 15 seconds in order to facilitate arbitrage since arbitrage is what keeps the tracking error of the fund low. Because of the low trading cost and the availability of continuous information, arbitrage between the ETF and the underlying securities has become increasingly popular among hedge funds and high-frequency traders. (Marshall et al., 2010.)

The secondary market liquidity is also a distinctive feature compared to mutual funds that provide liquidity only at the end of the trading day. ETFs are traded intraday on an exchange creating an addition layer of liquidity to the market. However, trading activity

in the secondary market does not imply creation and redemption activity since investors can trade with each other or APs. (Madhavan, 2016, 31-32.) The trading activity in the secondary market is, according to Investment Company Institute statistics (2018), four times the creation/redemption activity.

2.1.3 ETFs in the Nordics

Even though nearly all studies made on ETFs concentrate on the US market, the same structure and features found in the ETFs holding US companies can be found in the ones holding shares of Nordic companies. This is mainly since ETFs with large ownerships in Nordic companies are held by large international investment management companies such as BlackRock and S&P. Based on the data retrieved from Thomson Reuters Eikon database, there are nine ETFs in total based in the Nordics. The Nordic ETFs are presented in Table 1.

Table 1

ETFs based in the Nordics (20.9.2019)

Name	Domicile	Market cap EURm	Management fee	iNAV update
XACT OMXS30 ETF	Finland, Norway, Sweden	702	0.10%	3 min
DNB OBX ETF	Norway, Sweden	104	0.30%	NA
XACT Sverige (UCITS ETF)	Finland, Norway, Sweden	270	0.15%	3 min
Seligson & Co OMX Helsinki 25 ETF	Finland	264	0.16%	"Frequently"
XACT OBX (UCITS ETF)	Norway	71	0.30%	3 min
XACT Norden (ETF)	Finland, Norway, Sweden	1 191	0.15%	3 min
XACT Svenska Smabolag (ETF)	Sweden	160	0.30%	3 min
XACT OMXC25 (UCITS ETF)	Denmark	16	0.20%	3 min
XACT Nordic High Dividend Low Volatility ETF	Sweden	199	0.30%	3 min

In total, there are three companies providing ETFs in the Nordics: Xact, DNB and Seligson & Co. Xact is a leading Nordic ETF provider, DNB is one of Norway's largest financial services groups and Seligson & Co is a Finnish investment company. Of the nine ETFs, seven are provided by Xact. The scarcity of Nordic ETFs supports the notion that ETFs owning Nordic companies are in most cases not from the Nordics, but from large international financial institutions. However, there seem to be no significant differences between ETFs outside of the Nordics investing in Nordic companies and Nordic ETFs.

All of the ETFs presented in Table 1, follow a certain equity index or group of shares, are traded intraday and have large financial institutions as APs. For instance, ETFs Seligson & Co OMX Helsinki 25 ETF is a fund investing in shares listed in the Helsinki stock market and aims to follow the benchmark index with as low expenses as possible. The shares of the ETFs are traded similarly to regular shares during the opening times of the stock market.

The average expense ratio of the Nordic ETFs is 0.22% in 2018 whereas Morningstar's study on U.S. funds reported the average asset-weighted expense ratio to be 0.44% in 2018 among ETFs. (Monrningstar, 2019.) The expense ration in the Nordics seems to be lower than in the US but no meaningful generalizations can be made from a such small sample. The low expense ratio may compensate for lower liquidity or perhaps it is based on local competition.

APs are often stated to be large financial institutions. Same can be said about APs of Nordic ETFs. For instance, the banks acting as APs for Seligson's ETF include Handelsbanken, Danske Bank, Deutsche Bank, Evli, Nordea and Morgan Stanley, i.e. large financial institutions.

Finally, commonly ETF sponsors provide the indicative net asset value (iNAV) every 15 seconds in order to facilitate arbitrage. This is where the most significant differences seem to lie. ETFs presented in Table 1 reported varying iNAV updating frequencies. Xact reported that iNav for its ETFs are updated every 3 minutes, which is already infrequent compared to every 15 seconds. Seligson reported to update its iNAV "very frequently", which is a fairly ambiguous statement. DNB stated that it updates its NAV five times a week, once a day but does not mention the indicative NAV. In conclusion, based on basic characteristics of ETFs, Nordic ETFs do not differ from other international ETFs significantly, except for the frequency it facilitates its investors with indicative net asset values. The fact that ETF managers in the Nordics do not provide the iNAV as frequently that the theory would suggest, it might have an effect on the efficiency that the market price of the ETF is able to follow the net asset value of the fund.

2.2 Dynamics of arbitrage

2.2.1 Efficient market hypothesis and limited arbitrage

The efficient market hypothesis (EMH) has been a central theory in finance for nearly fifty years. Fama (1970) defined the efficient market as one in which all prices always fully reflect all available information. In other words, no investor can continuously beat

the market on average and therefore everyone should only passively hold a market portfolio.

The theoretical foundations of EMH rely on three assumptions. First, investors are rational and therefore value securities rationally. Second, in case of irrational investors, their trading is assumed to be non-correlated and random and should therefore cancel each other out. Third, in case of correlated irrational trading, the price impact of irrational traders is eliminated by rational traders, i.e. arbitrageurs.

The efficient market depends on the efficiency of arbitrageurs. Sharpe and Alexander (1990) define arbitrage as 'the simultaneous purchase and sale of the same, or essentially similar, security in two different markets at advantageously different prices.' Therefore, arbitrage does not require capital and is risk free (Shleifer & Vishny, 1997). Suppose a security is over-priced relative to its fundamental value, e.g. its risk adjusted net present value of its cash flows, because of an irrational investor. An arbitrageur would in this case sell the over-priced security and purchase a similar security to hedge the risk of the position. The arbitrageur would then earn a profit by selling and purchasing substitutes. The activity of arbitrageurs would then bring the price of the security to its fundamental value. (Shleifer, 2000, 3-4.) If arbitrage is effective, meaning that substitutes are available, and arbitrage is competitive, prices never diverge far from their fundamental value (Scholes, 1972).

However, in contrast to the EMH, arbitrage is risky and therefore limited. There might not be substitutes available and arbitrage comes with transaction cost, which both limit arbitrage. Even arbitrage between identical securities and with no transaction cost can be risky since mis-pricing might deepen in the short run due to investor sentiment. Shleifer (2000, 51-52, 87) proposes two conditions of how investor sentiment could affect asset prices. First, trading of individual investors is systematic and simultaneous. Second, arbitrageurs have limitations that prevent them to exploit the mispricing of irrational investors.

The first condition suggests that in order for irrational investors to have a significant impact on asset prices, should individual investors be systematically and simultaneously purchasing and selling the same securities, i.e. trading decisions should be correlated.

The impact of an individual investor in asset prices should be close to non-existing. However, if trading behavior is very correlated and systematic, individual investors can impact the asset prices. This group of individual investors is called 'noise traders'. (Barber et al., 2009.) Noise traders are investors that make trading decisions based on noise rather than information and interprets noise as fundamental information. According to traditional financial theories, identical securities should be priced alike due to arbitrage, but this is not always the case. The additional risk caused by noise traders have been found to be one reason why.

Shleifer (2000, 33-34) predicts that noise trader risk might be market wide rather than idiosyncratic. Therefore, noise trading may affect the market or a large group of securities. This would make noise trader risk systematic. The assumption that noise trader risk is systematic requires that securities affected by noise traders should have positive return correlation, even though the fundamentals would not be.

When researching ETFs, Ben-David et al. (2018) found the arbitrage activity of APs to be limited and therefore when the non-fundamental trading in the ETF is systematic enough, the price of the ETF will be affected for a protracted period. In addition, because of the arbitrage activity not only will the ETF be affected by the non-fundamental demand but also the underlying shares. Greenwood (2005) extends the limited arbitrage theory by creating a model on the effects of multiple demand shock on asset returns in a setting with limited arbitrage. The model predicts that securities correlated with an asset facing a demand shock should experience returns because of its hedging role in the arbitrageur's portfolio. This theory will be further discussed in the next section.

2.2.2 Shock propagation with limited arbitrage

Greenwood (2005) developed a framework to examine the dynamics of asset prices in an unexpected event in which several assets simultaneously experience a non-fundamental liquidity shock through uninformed investor demand. Demand shocks often affect several securities at the same time, but in different proportions. Simultaneous demand shocks can occur through several different channels including portfolio restructuring, index arbitrage, swap sales or liquidating of a fund, since all cases involve simultaneous trading of multiple stocks.

The limited arbitrage model developed by Greenwood (2005) describes the response of asset prices to an unexpected simultaneous change in investor demand in several securities. The limited arbitrage model is summarized as follows. The capital market consists of many risky assets with a limited supply. Simultaneously at time t, the securities face an unexpected demand shock changing the net supply of the assets. Arbitrageurs accommodate the demand shock but receive higher expected returns as a compensation for the increased risk. The event returns decline over time reversing the returns caused by the demand shock.

The model proposes three different assumptions that are confirmed through an empirical study. First, the model predicts an increase in asset prices following an increase in demand for the asset or asset group. Further, the security price changes in proportion to its contribution to the total risk of the diversified portfolio. In other words, the return is proportional to the covariance of fundamental risk of the asset. The higher the demand

shock is and the higher the covariance with other securities, the higher is the impact of the shock.

The second assumption proposes that also other assets, that are not directly affected by the demand shock, experience event returns because they play a hedging role in the arbitrageur's portfolio. Stocks whose fundamentals are positively correlated with stocks that experience a positive (negative) demand shock will experience a positive (negative) price impact, though no direct demand change has occurred.

For example, let's assume two assets, asset 1 and 2, that are positively correlated. Asset 1 experiences a non-fundamental positive demand shock through an index trader. Asset 2 will then experience positive event returns even though there is no change in demand. The positive event return in asset 2 arise from the fact that arbitrageurs must be compensated for their short position in asset 1. Therefore, the risk of the short position in asset 1 is hedged by a long position in asset 2 driving up the price of the second asset. In conclusion, prices of securities that are not directly affected by the demand shock are affected by it as arbitrageurs use them for hedging.

The third assumption proposes a negative linear relationship between the initial return associated with the change in demand and the post-event returns. The initial return is the change in price that the arbitrageurs require that they can have positive expected returns following the event. However, this price change is expected to revert linearly over time.

Greenwood (2005) assumes that two types of agents operate in the market: index traders that on a fixed quantity of securities, denoted by N × 1 vector *u*, and arbitrageurs. The first proposition suggests that a demand shock *u* followed by the vector of price changes is given by

$$P_{t^*} - P_{t^*-1} = \varepsilon_{t^*} + \gamma \sum((T - t^*)u + Q), \tag{1}$$

where *P* is the price of the security, ε_{t^*} is the information shock announced at time *t**, $\sum$ is the covariance matrix of fundamentals, *u* is the vector of demand shocks and *Q* is the vector of fixed supply. The proposition states that the vector of price change is proportional to the covariance matrix of fundamentals and the vector of demand shocks. The term ε_{t^*} can be interpreted as new fundamental information received to the market and $\sum Q$ the average required return of the market portfolio. There are two reason why changes in supply affect prices: risk aversion of arbitrageurs and uncertainty of future fundamentals. If arbitrageurs would be risk neutral or future fundamentals were not uncertain, arbitrageurs would take infinitely large positions against mis-pricing but this is usually not the case. In the first equation, the constant term *(T − t*)* can be interpreted as the "horizon-related multiplier". The terminal date represents the resolution of uncertainty or end of return reversal. In the case that *T* would be large relative to *t**, noise would

become an additional source of risk as returns reversed between any two periods would diminish.

The second assumption proposes that also securities that are not directly affected by the demand shock but are correlated with the affected securities are also affected by the shock. The expected event returns for securities affected by the demand shock are given in Equation 1 and returns of securities not directly affected by the shock is given by

$$P_{t^*} - P_{t^*-1} = \varepsilon_{t^*} + \gamma \emptyset'((T - t^*)u_1 + Q), \quad (2)$$

where the ($M \times N$) covariance matrix between the fundamentals of the M affected securities and the N unaffected securities is denoted by $\emptyset$ and u_1 is the $M \times 1$ vector of demand shocks for the M affected securities.

The third assumption proposes that the initial return associated with the demand shock will revert over time. The expected price reversion, for the affected securities, between the event period t^* and k periods after the event is given by

$$E_{t^*}(P_{t^*+k} - P_{t^*}) = k\gamma \sum(Q - u), \quad (3)$$

where Q is the vector of fixed supply and u is the vector of index traders' demand change. The post-event returns are negatively proportional to event returns, and reversal occurs when t approaches T.

The expected post-event returns, for securities not affected by the demand shock, between period t^* and k periods after the event is given by

$$E_{t^*}(P_{t^*+k} - P_{t^*}) = k\gamma \emptyset'(Q - u_1), \quad (4)$$

where the covariance matrix of fundamentals $\sum$ is substituted with the covariance matric of fundamentals between M and N.

In the next section, we are going to discuss how liquidity shocks in ETFs are transmitted to the underlying securities. The section proposes two alternative theories on the reasons behind the shock propagation, the first one being in line with the limits-to-arbitrage model provided by Greenwood (2005).

2.2.3 ETFs and liquidity shocks

Ben-David et al. (2012) studied if arbitrage between an ETF and the underlying securities could create a new channel of shock transmission, in other words, if the presence of ETFs could cause contagion in the financial markets. The results showed that ETFs can propagate non-fundamental liquidity shocks across asset classes that are tied to the ETF through

arbitrage channels. In addition, the study found supporting evidence for theories related to limits of arbitrage. Arbitrage does not only move prices for shares that are inefficiently priced but also for correctly priced shares if limits of arbitrage is present. When traders are affected by limits of arbitrage, liquidity shocks can be transmitted to another asset.

Ben-David et al. (2012) propose two theories on why ETFs cause shock propagation in the underlying securities; a *liquidity trading hypothesis* and a *price discovery hypothesis*. ETFs and the underlying securities are two assets with identical fundamentals and therefore should be priced alike. However, due to the structure of ETFs, they can be traded at prices that diverge from NAV.

The theories propose two reasons for the shock propagation: liquidity (liquidity trading hypothesis) and information (price discovery hypothesis). Information traders trade on the basis of information that is not known for everyone. Liquidity traders, on the other hand, trade for reasons that are not related to information or financial markets but rather for reasons that reflect the trader's personal liquidity needs, e.g. portfolio rebalancing. (Admati & Pfleiderer, 1988.)

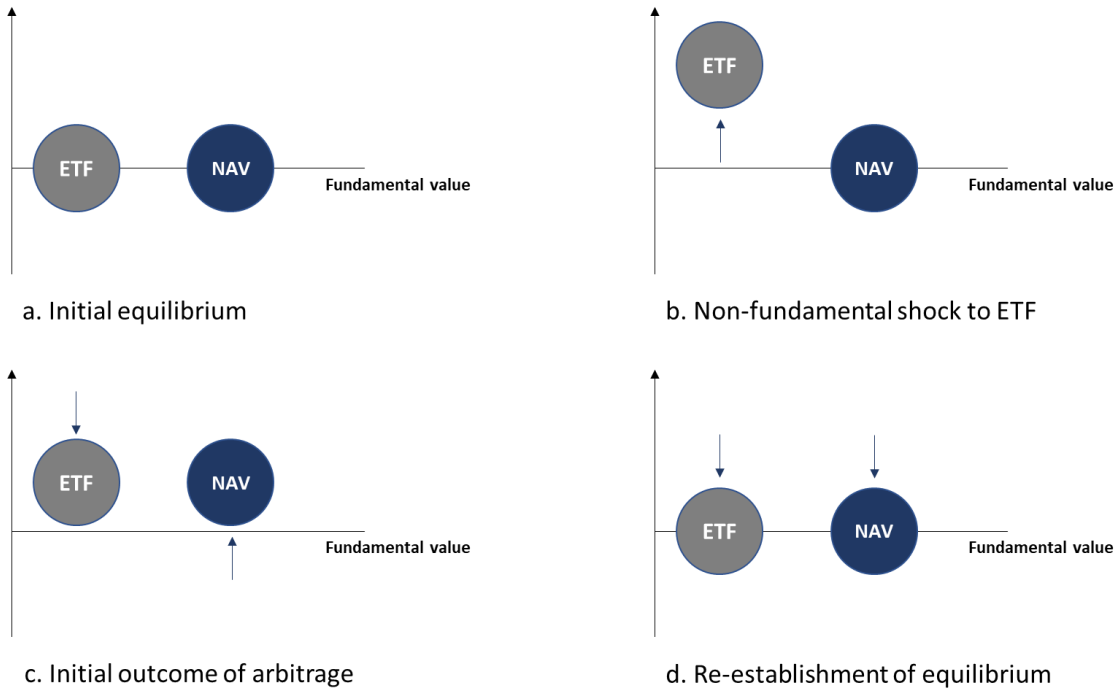

Figure 4 Non-fundamental shocks propagated through arbitrage (Adapted from Ben-David et al., 2012)

The first theory presented in Figure 4 suggests that ETFs are faced with a non-fundamental liquidity shock, that could arise from e.g. liquidity trades. Situation (a) represent the initial equilibrium where the price of the ETF is equal to NAV and both are priced at fundamental value. In situation (b) a non-fundamental shock, such as a large purchase, hits the ETF, putting positive price pressure on it and the price of the ETF rises above the

fundamental value. Since the price of the ETF deviate from NAV, arbitrage will take place. The arbitrage mechanism explained earlier will initially put negative price pressure on the ETF and positive price pressure on the NAV, but in the long run both NAV and the ETF will settle to the fundamental value. In this case, the shocks propagated to the underlying stocks through arbitrage are non-fundamental.

However, the first assumption on shock propagations is not alone sufficient enough since a similar effect could emerge from a fundamental shock. The second theory presented in Figure 5 proposes that the underlying security faces a new fundamental value as shown in situation (b). In the case that the ETF market would be more liquid than the underlying market, the ETF would recognize the price prior to the underlying market. The underlying security will recognize the new fundamental value with a delay.

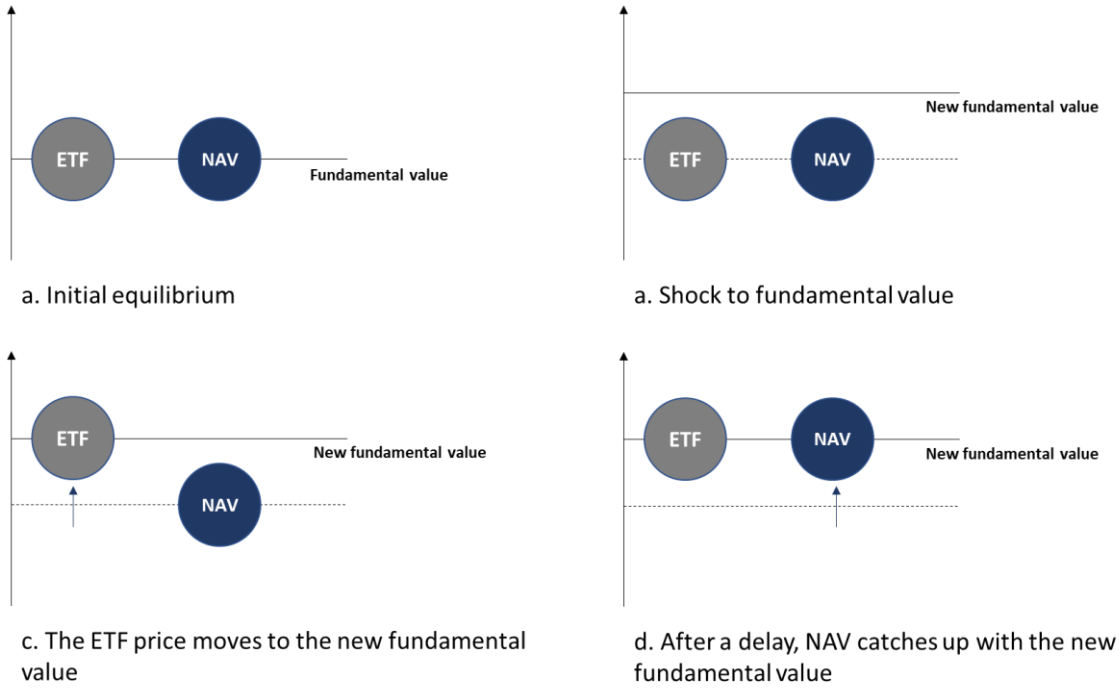

Figure 5 Fundamental shock with price discovery in the ETF (Adapted from Ben-David et al., 2012)

If the second theory would be the case, that would mean that the liquidity shock would hit the underlying security anyway, even if there would be no ETFs. The hypothesis of this study, however, is that the shock propagations emerging from the ETFs may be destabilizing for the underlying securities. In the second theory this would not be the case since shocks would hit the securities with or without ETFs.

Ben-David et al. (2012) argued that if the first theory presented in Figure 4 would be true, the underlying securities would initially face positive price pressure but later revert to the fundamental value. This was found to be the case and shocks were discovered to propagate through the arbitrage mechanism.

The fist assumption provided by Ben-David et al. (2012) and explained above is in line with the limits-to-arbitrage model by Greenwood (2005). The ETF and the underlying securities have identical fundamentals and are correlated. In the presence of limited arbitrage, arbitrageurs require a compensation for accommodating the demand shock and for taking on increased risk. As per Greenwood (2005) the demand shock will cause an increase in the price of the ETF (first assumption). Since the underlying securities are correlated to the ETF, arbitrageurs will use the securities as a hedge driving up the price of the underlying securities and therefore NAV (second assumption). In a long run the prices will revert to the equilibrium (third assumption).

As stated earlier, the impact that individual investors have on assets should be negligible but if the trading of noise traders is systematic and correlated enough, they could have an impact on the securities. Ownership of ETFs in shares may inject a new layer of noise to the underlying securities through the non-fundamental demand shocks. The prices ETFs that are affected by noise-based liquidity shocks start to diverge from NAV. Arbitrageurs will start to exploit the price difference and bring the price of the ETF back to its fundamental value.

However, as explained by Ben-David et al. (2012), before the price of the ETF reverts to its fundamental value, the underlying securities will be affected by the noise through arbitrage. Since arbitrage is limited, i.e. it's risky, arbitrageurs demand compensation for the risk that they take while taking part in the arbitrage process. Risk-averse arbitrageurs will use the underlying securities as a hedge and transmit the liquidity shock into them. Over time both prices will revert to their fundamental levels. However, if these non-fundamental liquidity shocks are frequent enough, ETFs may cause a new layer of risk to the underlying securities.

2.3 Earlier empirical studies on the effect of ETFs on stock market

Earlier empirical studies have found wide evidence that institutions have a role in non-fundamental demand shocks that affect asset prices because of their investors. In addition, recent empirical literature has studied the effect of ETFs on asset prices. However, there is only a limited number of studies made on how ETFs affect the volatility of the underlying securities, especially in markets outside of the US. In this section, we are going to discuss recent empirical literature related to this study.

The main influence for this study is a paper by Ben-David et al. (2018) that discovered that stocks that have a significant ETF ownership experience substantially higher volatility than stocks with small ETF ownership. The study suggests that the arbitrage between the exchange-traded funds and the underlying assets add a new layer of trading to the stocks held by these ETFs. Trading shocks that occur in the ETF market are transmitted

to the underlying securities through the arbitrage process leading to growth in non-fundamental volatility in the securities. In addition, Ben-David et al. (2018) argue that the increase in volatility appears to introduce undiversifiable risk in prices because stocks with high ETF ownership earn a significant risk premium. Ultimately, the evidence suggests that ETFs are a new source of systematic risk. The study was made using data from the US market.

Volatility has been found to increase also in other markets after the introduction of ETFs. Lin and Chiang (2005) studied the change of volatility if the Taiwanese market after the introduction of the first ETF. The study demonstrated that the volatility of the underlying stocks did increase after the establishment of the first ETF. The volatility did not differ among different size categories but volatility in the financial and electronical sector increased significantly while volatility in the mixed sector reduced.

Even the real estate sector has found to be affected by ETFs. ETFs have made the real estate sector more accessible, but the introduction of real estate ETFs were discovered to significantly increase volatility in the underlying real estate stocks. Curcio et al. (2012) found that leveraged ETFs tied to the Dow Jones US Real Estate and Financial Indices caused the most significant volatility increase tripling the volatility of the underlying securities. Traditional ETFs on the other hand caused a 70 percent increase in volatility. No other external events were found that could have attributed to the increased volatility.

Ben-David et al. (2018) among others have stated that the rise in volatility may be caused by the commonality of fund flows that cannot be explained by the fundamentals of the stock. A large body of literature in fact show that flow-induced trading has a non-fundamental effect on asset prices. Vayanos and Woolley (2013) suggest that flows of investors of mutual funds push prices away from fundamental value. In addition, the study found that flows generate momentum, reversal and comovement of share prices.

Coval and Stafford (2007) studied institutional price pressure in equity markets by studying mutual fund flow-induced trading. The study showed that funds experiencing large outflows tend to decrease their existing position and thus adding pressure on the prices of the underlying securities. Similarly, funds experiencing significant inflows increase their position putting positive price pressure on the securities. Therefore, if flow-driven purchases or sales are widespread, these forced transactions result in institutional price pressure.

Basak and Pavlova (2013) suggest that institutions care about their performance related to a certain index. In addition, institutional investors tend to tilt their portfolios towards the benchmark index resulting in an increased price pressure on the index stocks. The study shows that institutional investors demand for more risky securities compared to retail investors and thus amplify the volatility of index stocks.

Anton and Polk (2014) show that shared ownership by an active mutual fund cause excess comovement in the underlying shares. In other words, shares are connected with

each other through mutual fund owners that they have in common. Further, stocks that are connected by their mutual fund ownership covary more while controlling for systematic return factors and sector similarity among other factors. Therefore, the degree of shared ownership in the shares forecast cross-sectional variation in return correlation.

Finally, Greenwood and Thesmar (2011) studied stock price fragility and showed that volatility and comovement can be forecasted with asset fragility. The study suggests that assets are fragile when ownership is concentrated or when owners experience correlated liquidity shocks. The study was made using mutual fund ownership of US stocks.

Because of the unprecedented growth of the ETF industry, ETFs have gained a lot of interest from academics who have been arguing whether ETFs have a destabilizing effect on the securities market. Agarwal et al. (2018) examined the impact of ETFs on the similarity of liquidity in the underlying stocks, while controlling for other institutional investors. The results showed that ETF ownership indicate a significant increase in commonality and that greater arbitrage activity is associated with an even larger commonality effect in share liquidity. The study concluded that ETFs may reduce the ability of investors to diversify liquidity risk.

Da and Shive (2018) too suggested that ETF ownership could lead to a larger commonality. The study provides empirical evidence that ETF arbitrage could be a new source of return comovement as the arbitrage activity between the ETF and the underlying portfolio could generate non-fundamental shocks to the stocks they hold. The analysis showed that ETF turnover is an important determinant of the comovement and that ETF-induced return comovement could be excessive, as there seemed to be a sub-sequent price reversal in both fund level and stock level. However, Da and Shive (2018) pointed out that ETFs do have some benefits as they provide a cheaper and more efficient way to diversify a portfolio but at the same time the excessive comovement among the asset may be costly to many investors, both institutional and individual.

Leippold et al. (2016) studied if stock return correlations could be driven by trading in index-tracking products, in addition to the correlation in the fundamentals of the stocks as traditional financial theory suggests. The index-tracking products used in the study were ETFs and futures. The results implied that index-trading activity can explain a large part of the time variation in stock return correlation. In addition, a surprising implication of the study was that index demand shocks may affect the correlation of non-index stocks even though index stocks were found more sensitive to shocks. Furthermore, ETFs were found to have a stronger impact on correlations than futures.

In conclusion, recent empirical studies suggest that institutional ownership in shares may imply that fund flows cause pressure on the share prices and may increase comovement in the underlying stocks.

However, several studies researching the relation between institutional ownership and the underlying stock have found that institutional investors often act as liquidity providers

for the underlying stock (Dang, 2018; Rubin and Smith, 2009). Rubin and Smith (2009) suggests that in addition to added trading volume, institutional investors increase competition among informed investors leading to a more efficient market.

Dang (2018) studied the effect globally in both developed and emerging countries and found that institutional ownership is positively related to share liquidity. This effect was found to be even stronger among stocks in less evolved and liquid markets.

Agarwal (2007) on the other hand found that institutional ownership has a non-linear effect on liquidity. When institutional ownership is moderate, they seem to act as liquidity providers but as the ownership exceeds 40%, information asymmetry takes place and the effect weakens.

As the results of earlier empirical studies show, the results do not seem to be completely consistent with each other, but some important factors can be found that may affect the results. First, the effect that a certain ownership may have on the underlying share is dependent on the composition of the ownership. Different forms of ownership may have an opposite effect on the shares (Dang, 2018). Second, the market of trading affects the impact of the ownership. As studies have been made in other less evolved and less liquid markets than the US, the results received have often been different. Third, the level of certain ownership seems to affect the impact that the ownership has on a share as Agarwal (2007) demonstrated.

3 DATA AND METHODOLOGY

3.1 Sample selection and data collection

The study focuses on Nordic listed companies that are included in the Nasdaq OMX Nordic 120 index[1]. The companies included are presented in the Appendix D. This specific index was chosen since it provides a broad sample of publicly listed companies in the Nordics. One share, Ericsson B, was excluded from the study due to its abnormal trading behavior. For example, in some months the share was traded only on one day. Of the remaining companies 55 (54%) are Swedish, 21 (21%) Finnish and 26 (26%) Danish.

The time frame for the study is 10 years from 1.1.2009 to 31.12.2018 and the frequency of the data collected is monthly. Therefore, each company will have 120 time series data points if the company has been listed throughout the time period. In total, 11 companies were listed during the time frame and have therefore incomplete time series data. The companies listed during the time frame of the study are added to the data as they were listed.

The data used for this study is collected from Thomson Reuters Eikon database to form a panel data. Due to unobserved data, e.g. for companies listed during the time frame, the panel data is unbalanced. ETF ownership data was collected by retrieving fund ownership data from Thomson Reuters Eikon database and sorting ETF owners from the list of fund shareholders by the terms "ETF", "Exchange-traded fund" or "Indeksiosuusrahasto" (Seligson's exchange-traded fund). During the collection of the data, Seligson's ETF was the only one that included the word "Indeksiosuusrahasto" in Thomson Reuters Eikon database.

Other forms of ownership were collected from Fund Ownership History Reports. Other daily stock market data used in this study was also retrieved from Thomson Reuters Eikon database as either cross-sectional data from the last day of the month or average data from the trading days of the month. All data used in the study, excluding company name and sector, is time series data.

In this study, the focus will be on the companies that are owned by ETFs and how the shares of these companies are affected by ETFs. The investment style or behavior of specific ETFs will not be addressed. Therefore, only equity ETFs will be included in the study and ETF derivatives will not. ETFs will be considered as a group of institutional investors and studying of individual ETFs will not be included in the study.

[1]Nasdaq OMX Nordix 120 included 102 companies on March 16, 2019 when the data was retrieved from nasdaqomxnordic.com. It was noted that including only current companies included in the index to the study would expose to survivorship bias, but the effect was estimated to be negligible.

3.2 Methodology and sample characteristics

3.2.1 ETF ownership and share volatility

The first research question I am going to address is how ETF ownership affects share volatility. The research problem was largely influenced by the study made by Ben-David et al. (2018) who focused on the US market only. However, the Nordic markets differ significantly from the US market for example in terms of size and liquidity. The rising trend of ETFs has landed in the Nordics too and therefore it is important to understand the implications that ETFs may have on the financial markets in a smaller and more illiquid market. Since no studies have been made on the subject using data from Nordic countries, I am going to extend the study made by Ben-David et al. (2018) in order to provide new information on how ETFs affect the volatility of the underlying stock.

The study is quantitative and applies regression analysis to examine the dependence of ETF ownership on volatility. I conduct my main test of how ETF ownership, the fraction of shares owned by ETFs, is correlated with stock level volatility. A panel data is constructed to capture both time and individual companies for more efficient estimates. We run a regression on panel data, controlling for month and share fixed effect using the following model:

$$Volatility_{it} = \alpha + \beta \times ETF\ \widehat{ownership}_{it} + Controls + Fixed\ effects + \varepsilon_{it}, \quad (5)$$

where α is constant, β is the coefficient, *ETF ownership* is either ETF ownership %, ETF ownership flow or weighted ETF turnover %, *controls* are the controlling variables, *fixed effects* are company fixed effects and month fixed effects and ε_{it} is the error term.

Stock level volatility, the dependent variable in the model, is calculated using daily returns of each stock in a given month,

$$Volatility_{i,t} = \sqrt{\frac{1}{D_{it}} \sum_{i=1}^{D_{it}} (r_{id} - \overline{r_{it}})^2}, \quad (6)$$

where D_{it} is the number of days for which data is available for stock *i* in month *t*, *r* is the return of stock *i* on day *d* and $\bar{r}$ is the return of stock *i* in month *t*.

In order to calculate the ETF ownership percentage, the number of shares held by ETFs was divided by the number of shares outstanding on that same date. The frequency of the ownership data is monthly and therefore of the frequency data for the regression is monthly as well. All data is either a cross section on the last day of the month or an average figure of the data collected during that month.

ETF ownership of stock *i* in month *t* is defined as the number of shares held by ETFs at the end of the month divided by shares outstanding at the end of the month,

$$ETF\ ownership\ \% = \frac{\sum_{j=1}^{J} Number\ of\ shares\ held\ by\ an\ ETF_{j,t}}{Shares\ outstanding_{i,t}}, \qquad (7)$$

where *J* is the number of ETFs holding stock *i*. A summary of annual ETF holdings in the shares included in out sample is shown in Table 1.

In addition to ETF ownership level, we construct two alternative measures of ETF ownership: weighted ETF turnover percentage and ETF ownership flow percentage. ETF ownership flow captures if the change in volatility is not only caused by the level of ETF ownership but rather by the in and out flows of ETF ownership i.e. creation and redemption activity. ETF turnover % on the other hand is the ratio of how many times the fund manager has turned the whole portfolio on an annual basis. This variable is calculated as a weighted ETF turnover in order to make it proportional to the ETF ownership.

ETF ownership flows are calculated as follows

$$ETF\ ownership\ flow_{i,t} = Log\left(\frac{ETF\ ownerhsip\ \%_{i,t}}{ETF\ ownership\ \%_{i,t-1}}\right), \qquad (8)$$

where *ETF ownership %$_{i,\,t}$* is the ETF ownership percentage on the last day of month *t* and *ETF ownership %$_{i,\,t-1}$* is the ETF ownership percentage on the last day of the previous month. In this study ETF turnover % has been calculated for the last twelve months as weighted arithmetic mean and multiplying this by the total ETF ownership % in order to capture the weight that the ETF turnover would have on the share:

$$\begin{aligned} Weighted\ ETF\ turnover\ \%_{j,LTM} &= \sum_{j=1}^{J} ETF\ ownership_{i,t} \\ &\times \sum_{j=1}^{J}\left(\frac{ETF\ turnover\ \%_{j,LTM} \times ETF\ ownership\ \%_{j,i,t}}{\sum_{j=1}^{J} ETF\ ownership_{i,t}}\right), \end{aligned} \qquad (9)$$

where *j* is the ETF holding share *i* at time *t*. In order to control for other institutional investors, hedge fund ownership and index fund ownership are controlled for in the regression. Similarly to ETFs, hedge funds are also likely to trade at a higher frequency and therefore should be controlled for. Both index and hedge fund ownership are calculated in the same way as ETF ownership. To illustrate the increasing importance of ETFs, I present statistics in Table 2 to compare other forms of institutional ownership to ETF ownership.

Table 2

Institutional ownership holdings

This table presents the development of three different institutional ownership holdings between 2009-2018. Each holding is the year end cross-sectional ownership percentage. Each institutional holding, ETF ownership, index fund ownership and hedge fund ownership is calculated as the number of shares held by each fund divided by the number of shares outstanding.

OMX Nordic 120										
		ETF			Index Funds			Hedge Funds		
Year	Number of Companies	Percentage of Market Cap	Market Cap (EURm)	Market Cap divided by Companies	Percentage of Market Cap	Market Cap (EURm)	Market Cap divided by Companies	Percentage of Market Cap	Market Cap (EURm)	Market Cap divided by Companies
2018	101	2.07%	127,668	1,252	6.38%	435,672	4,271	0.43%	30,350	298
2017	98	1.81%	140,680	1,421	5.88%	460,846	4,655	0.38%	35,321	357
2016	97	1.39%	90,606	925	4.56%	325,451	3,321	0.44%	33,341	340
2015	94	1.42%	84,715	892	3.93%	258,860	2,725	0.32%	24,051	253
2014	93	1.34%	69,043	734	3.14%	201,549	2,144	0.24%	16,530	176
2013	90	1.13%	74,536	819	2.78%	157,385	1,730	0.18%	12,373	136
2012	90	0.88%	49,972	549	2.29%	112,014	1,231	0.27%	9,544	105
2011	89	0.86%	34,436	383	2.17%	87,813	976	0.29%	7,085	79
2010	87	0.68%	34,882	396	2.23%	103,780	1,179	0.35%	9,955	113
2009	86	0.62%	22,584	260	2.24%	79,746	917	0.34%	9,319	107

During the ten-year-period, ETF ownership in Nordic shares has increased by 234% from 0.62% in 2009 to 2.07% in 2018. Index funds, which are the closest substitutes for ETFs since ETF holdings are included in the index fund holdings, has increased nearly at the same rate as ETF holdings. Index fund holdings have grown 185% from 2.24% to 6.38%. Hedge fund ownership has also grown during the time period but at a more moderate rate than index or exchange-traded fund ownership. Hedge fund ownership has grown only 26% during the ten-year period.

A lot of the growth of ETF ownership in shares can be explained by the increased number of ETFs in the market investing in Nordic companies but ETFs have also increased their stakes in the companies. This notion can be confirmed visually in Figure 6 and, in addition, Table 2 presents how the market capitalization owned by ETFs has grown significantly over the years.

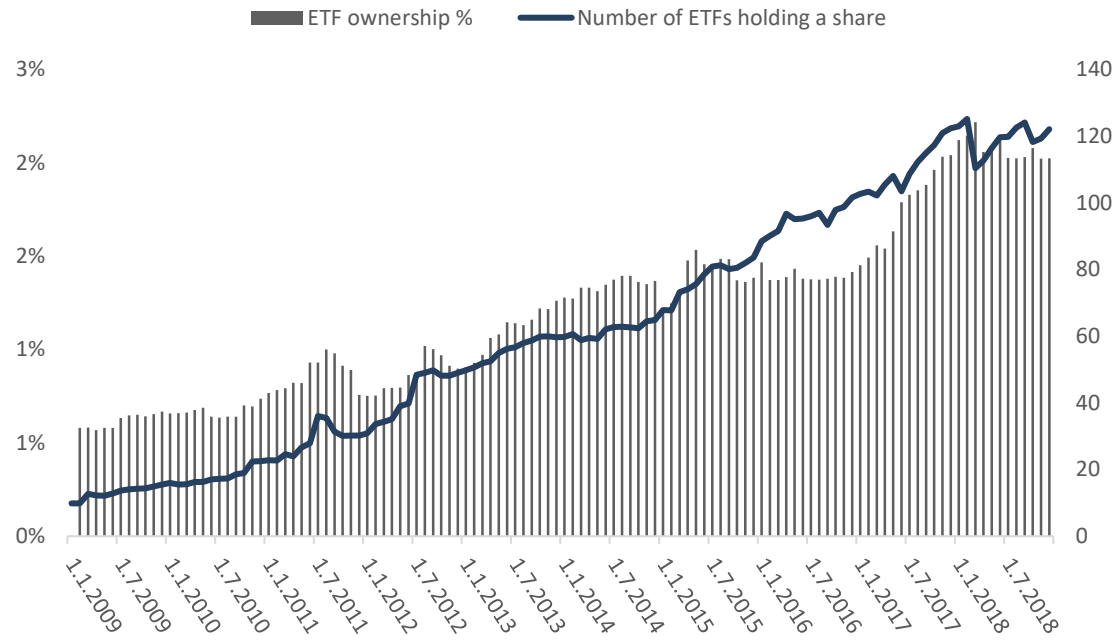

Figure 6 Development of ETF ownership in the Nordics 2009-2018

Even though the growth of ETF ownership has been great during this time frame, it is not nearly at the same level as it is in the US. Comparing this data with the data from the study made by Ben-David et al. (2018) ETF ownership percentage is much lower in the Nordic than in the US. In 2015 Ben-David et al. (2018) reported the ETF ownership to be 7.48% whereas in the Nordics it was 1.42% during the same time.

In order to capture the true effect that ETF's have on volatility, the regression controls for other factors that may affect daily share volatility. In Table 3, it can be observed that company market capitalization is highly correlated with share volatility. Therefore, it can be interpreted that larger and more established companies are usually included in more

indices than smaller companies, leading to a higher ETF ownership. Further, larger companies tend to be more liquid than smaller, less traded companies.

In order to control for these factors, we add controls measuring company size and share liquidity. Size effect is captured by the logarithmic market capitalization and liquidity effect by trading volume percentage, Amihud ratio (2002) and bid-ask-spread percentage. All of these factors are calculated as monthly averages prior to the day ETF ownership is calculated.

Trading volume is calculated based on the number of shares traded during the past month that is standardized by the number of shares outstanding, as follows

$$Trading\ volume\ \%_{it} = \frac{Number\ of\ shares\ traded_{im}}{Shares\ outstanding_{it}}, \tag{10}$$

where number of shares of company *i* traded during month *m* is divided by shares outstanding on the last day of month *t.* Bid-ask spread is the amount that ask price exceeds the bid price. Bid-ask spread captures market liquidity as the spread reflects the trading cost. Bid-ask spread percentage is calculated as follows

$$Bid - ask\ spread\ \%_{it} = \frac{Ask\ price_{it} - Bid\ price_{it}}{Ask\ price_{it}}, \tag{11}$$

where stock *i*'s bid-ask spread percentage at time *t* is the difference of ask and bid price divided by ask price.

Amihud ratio is an illiquidity measure that gives the price impact of order flows (Amihud, 2002). Our study calculates a monthly Amihud ratio as follows

$$ILLIQ_{i,m} = \frac{1}{D_{im}} \sum_{i=1}^{D_{im}} \frac{|R_{imd}|}{VOLD_{imd}}, \tag{12}$$

where D_{im} is the number of days for which data is available for stock *i* in month *m*, $VOLD_{imd}$ is the trading volume in euros for stock *i* in month *m* on day *d* and R_{imd} is the return of stock *i* in month *m* on day *d*. As shown in Equation 12, Amihud ratio calculates the impact that trading volatility has on share price. As the ratio increases, the illiquidity of the stock increases.

In addition, the regression will control for other factors that may affect share volatility such as inverse share price, book to market ratio, gross profitability (gross income scaled by total assets, as in Novy-Marx (2013)) and skewness. Inverse share price is used instead of just share price due to the inverse relationship between stock prices and volatility. Month and stock fixed effects are controlled for since the amount of ETF holdings have increased significantly over the period and some industries and companies may have been

more popular or unpopular over time. Table 3 summarizes the dependent and controlling variables used in the regression.

There is no denying that ETFs have become more popular and significant in the Nordic market during the past ten years. However, the impact that they may have on the market is still widely unclear. In order to address the main research question, if ETF ownership has increased volatility, the volatility of each share listed on OMX Nordic 120 index and for each year during the ten-year period was calculated. Volatility was calculated as market weighted volatility of a portfolio constructed of shares included in the study for each month. The results are shown in Figure 7.

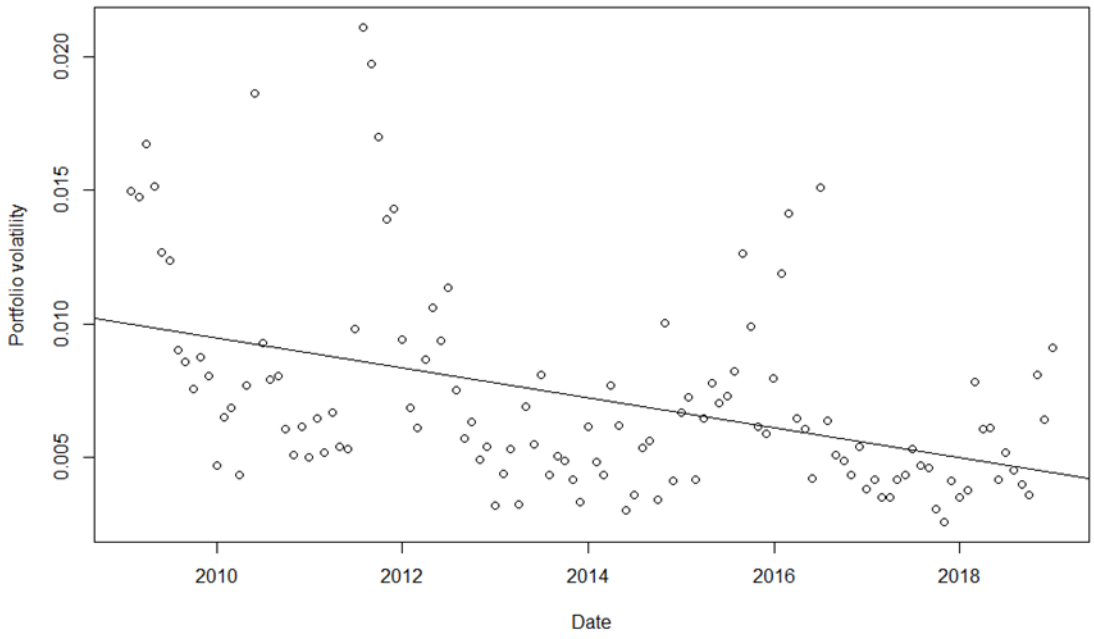

Figure 7 Portfolio volatility of shares included in OMX Nordic 120 2009-2018

Even though several studies conducted have reported that share volatility has increased during the past years (Washer et al., 2016), no such claim can be done from the Nordic market. There seem to be a clear downward trend in the market for volatility in the same period where ETF ownership has grown significantly. In fact, the correlation between ETF ownership and volatility is significantly negative during this time period as shown in Table 3, Panel B. No definite conclusions can be made from only this relation, but the initial data does not support the notion that the increasing ETF ownership has destabilized the Nordic markets.

Table 3

Panel data description

This table presents the panel data summary. The table includes the number of observations, the mean of the variable, standard deviation, minimum, median, maximum, skewness and kurtosis. *Daily stock volatility* is the monthly average daily volatility of each share calculated from the previous month. *ETF ownership* is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. *ETF turnover* is the weighted turnover of ETF's holding of the share. *ETF ownership flow* is the change in ETF ownership in the share each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's market capitalization on the last day of each month. *1/Price* is the inverse share price during the last day of the month. *Amihud ratio* is calculated as Amihud (2002). *Bid-ask-spread* is calculated as the average bid-ask-spread of a stock during the previous month. *Book to Market* is the book to market ratio of each company on the last day of each month. *12-month return* is the return of the stock during the previous year. *Trading volume* is the average daily trading volume of each share during the previous month. *Gross profitability* is calculated as Novy-Marx (2013). *Skewness* is the average daily skewness of each share during the previous month. *Number of ETFs* is the number of individual ETFs holding a share of a company. *ETF turnover* is the weighted turnover of ETF's holding of the share. *ETF flow* is the logged change in ETF ownership during a month.

Panel A: Panel data summary

	N	Mean	SD	Min	Median	Max	Skewness	Kurtosis
Daily stock volatility (%)	11,279	1.755	0.887	0.190	1.544	14.095	2.294	11.046
ETF ownership (%)	11,278	1.235	1.312	0.000	0.869	15.104	2.953	15.353
Index fund ownership (%)	11,279	3.563	2.952	0.000	2.880	22.767	1.704	4.280
Hedge fund ownership (%)	11,279	0.341	0.886	0.000	0.089	10.932	5.540	35.559
log(Market Cap EURm)	11,278	9.683	0.517	7.435	9.641	11.044	-0.095	0.030
1/Price	11,278	0.030	0.083	0.000	0.010	3.678	20.713	710.278
Amihud ratio	11,278	0.323	4.462	0.000	0.038	339.050	60.595	4095.594
Bid-ask spread	11,279	0.002	0.004	0.000	0.001	0.105	11.053	187.569
Book to Market	11,279	0.522	0.605	-0.097	0.364	12.701	5.491	62.076
Past 12 month returns (%)	11,145	16.605	41.185	-92.672	12.703	657.143	3.131	28.000
Trading volume (%)	11,278	0.452	0.551	0.005	0.301	11.448	5.623	58.837
Gross profitablity (%)	11,279	29.287	25.449	-1.032	24.917	147.708	1.597	3.447
Skewness	11,278	0.090	0.883	-4.074	0.100	3.992	-0.191	2.698
Number of ETFs	11,278	63.204	59.161	0.000	39.000	397.000	1.184	0.892
ETF turnover (%)	11,278	0.010	0.016	0.000	0.005	0.413	2.458	11.976
Log(ETF flow)	11,037	0.009	0.110	-2.279	0.005	1.958	0.710	104.603

Panel B: Panel data correlations

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Volatility	(1)	1,000															
ETF ownership	(2)	-0,138	1,000														
Number of ETF owners	(3)	-0,201	0,499	1,000													
Index fund ownership	(4)	-0,103	0,485	0,551	1,000												
Hedge fund ownership	(5)	0,030	-0,045	0,017	0,068	1,000											
Volume	(6)	0,295	0,160	-0,195	-0,049	0,026	1,000										
Bid-ask-spread	(7)	0,188	-0,144	-0,260	-0,076	0,161	0,177	1,000									
Amihud ratio	(8)	0,151	-0,096	-0,107	-0,125	-0,045	-0,069	0,147	1,000								
Log(Market Cap)	(9)	-0,239	0,119	0,585	0,249	-0,060	-0,293	-0,249	-0,065	1,000							
1/Price	(10)	0,232	0,010	-0,045	-0,064	-0,052	0,084	0,196	0,689	-0,166	1,000						
12-month return	(11)	-0,178	-0,021	-0,092	-0,042	0,045	0,035	0,037	-0,055	-0,031	-0,056	1,000					
Book to Market ratio	(12)	0,194	-0,121	-0,143	-0,071	-0,047	-0,032	0,147	0,285	-0,126	0,414	-0,161	1,000				
Gross profitability	(13)	-0,032	0,080	0,048	-0,025	-0,044	0,063	-0,009	-0,077	0,021	-0,036	-0,004	-0,396	1,000			
Skewness	(14)	0,031	-0,046	-0,094	-0,068	0,025	0,031	0,033	0,022	-0,073	0,019	0,087	0,006	-0,008	1,000		
ETF turnover %	(15)	-0,138	0,096	0,141	0,075	0,002	-0,058	-0,097	-0,049	0,072	-0,057	0,053	-0,080	0,043	-0,014	1,000	
ETF flow	(16)	-0,032	-0,091	-0,014	-0,017	0,018	-0,005	0,007	0,010	-0,019	0,017	0,016	0,010	-0,002	0,000	0,032	1,000

3.2.2 ETF ownership and share liquidity

There is an ongoing academic debate on how ETF ownership affects the liquidity of the underlying securities. While only few studies have been made on the link between ETF ownership and stock liquidity, the connection between ETF ownership and bond liquidity has been a more studied subject. However, the results are not consistent. While Dannhauser (2017) argues that higher ETF ownership is associated with lower liquidity in investment-grade bonds, another study by Nam (2017) found that bonds included in ETFs experience improvements in their liquidity.

Hamm (2010) investigated the effect of ETFs on the liquidity of individual stocks. The study found that the availability of ETFs as an alternative trading option is positively associated with share illiquidity. The reasoning behind these results come from prior analytical studies suggesting that uninformed investors prefer investing in diversified ETF's rather than individual stocks to avoid trading against informed investors (adverse selection). Consequently, individual stocks become less liquid due to this migration of investors from individual stocks to ETFs.

In this study, the connection between ETF ownership and share liquidity is investigated using three variables to depict liquidity: share turnover, bid-ask-spread and Amihud ratio. I run a regression to measure the effect of ETF ownership on liquidity while controlling for several factors that could affect the liquidity of a share in the following way:

$$Turnover_{it} = \alpha + \beta \times ETF\ \widehat{ownership}_{it} + Controls + Fixed\ effects + \varepsilon_{it}, \quad (13)$$

$$Bid - ask - spread_{it} = \alpha + \beta \times ETF\ \widehat{ownership}_{it} + Controls + Fixed\ effects + \varepsilon_{it}, \quad (14)$$

and

$$Amihud\ ratio_{it} = \alpha + \beta \times ETF\ \widehat{ownership}_{it} + Controls + Fixed\ effects + \varepsilon_{it}. \quad (15)$$

Controlling variables in all regressions include other forms of institutional ownership such as index fund and hedge fund ownership in order to specify which form of ownership is most associated with the dependent variables. In addition, several other controlling variables, that could affect share liquidity are included such as size, profitability, returns, book to market ratio, and free float percentage.

3.2.3 ETF ownership and return comovement

Da and Shive (2018) argued that along with information, ETFs may transmit non-fundamental shocks into the underlying shares. Demand in the ETF leads to price pressure in the stock as arbitrageurs take opposite positions in the ETF and the underlying stock. As a result, the underlying shares may start to comove more than they should based on their fundamentals. Therefore, arbitrageurs that are supposed to enforce price efficiency might cause excess comovement, consistent with the views of Shleifer and Vishny (1997), who studied the limits of arbitrage, and Hong et al. (2012), who argued that the prices of highly shorted stocks are excessively sensitive to shocks compared to stocks with little short interest. Da and Shive (2018) suggested that while ETFs have only little discretion in deciding when and what to trade, ETF arbitrage is more likely than any other type of correlated order flow to drive return comovement among its underlying stocks.

In order to study the effect of ETF ownership on return comovement in the Nordic markets, I first construct a measure of comovement as Parsley and Popper (2017) and examine the change in comovement over time. Then I partially replicate the stock level tests made by Da and Shive (2018) to understand the relation of comovement with ETF ownership and if the price movement if excessive.

To capture the return comovement of the shares over time, I use a model free comovement measure by Parsley and Popper (2017). I start by decomposing a portfolio with N firms and calculate the market return, r_m, with equal weights,

$$r_m = \sum_{i=1}^{N} w_i r_i, \tag{16}$$

where w_i is the weight of share i. Then I decompose the portfolio's return variance based on sum of two parts. The first part consists of the individual return variances and the second part consists of their covariances,

$$\sigma_m^2 = \frac{1}{N^2}\sum_{i=1}^{N}\sigma_i^2 + \frac{1}{N^2}\sum_{i=1}^{N}\sum_{\substack{j=1 \\ i\neq j}}^{N}\sigma_{i,j}^2 . \tag{17}$$

The pure comovement is captured by the second part of the equation. Next, I will look at the counterparts of each of these terms. I denote sample value of each individual return variance by s_i^2 and sample value of each covariance by c_i^2. Then I denote the corresponding average values by s^2 and c^2, where

$$s^2 = \frac{1}{N}\sum_{i=1}^{N} s_i^2 \quad \text{and} \quad c^2 = \frac{1}{N^2-N}\sum_{i=1}^{N}\sum_{\substack{j=1 \\ j\neq i}}^{N} c_{j,i}^2. \tag{18}$$

And with these two averages I will get the sample portfolio variance,

$$\hat{\sigma}_m^2 = \frac{1}{N}s^2 + \frac{N-1}{N}c^2. \quad (19)$$

Finally, I will get the comovement using c^2 as a share of the average individual variance, s^2,

$$\frac{c^2}{s^2} = \frac{N}{N-1}\left(\frac{\hat{\sigma}_m^2}{s^2} - \frac{1}{N}\right). \quad (20)$$

Using Equation 20 to capture share comovement over time, I find that comovement has decreased over the ten-year time frame. The results are shown in Figure 8. The common belief is that ETF ownership, and more broadly, the rise of index investing has increased comovement of underlying shares, cannot be confirmed based on this data. However, comovement has decreased over the years when ETF and index fund ownership has increased significantly.

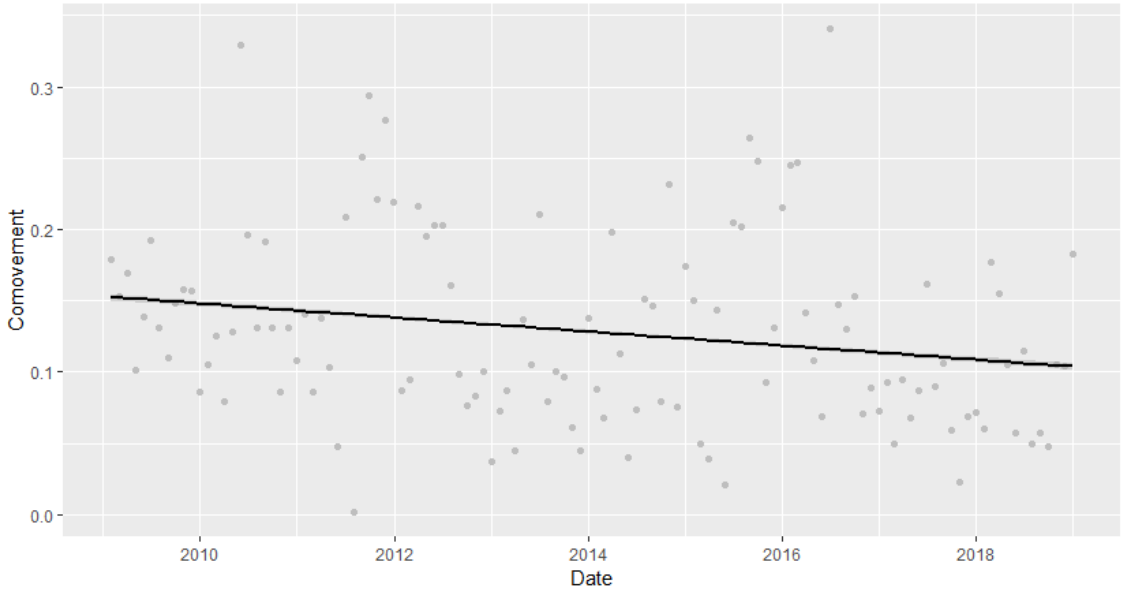

Figure 8 Fitted share co-movement in the Nordics 2009-2018

To further understand the effect of ETF ownership on comovement, I replicate in some parts the study made by Da and Shive (2015) on the effect of ETF activity on return comovement. Da and Shive concluded in their stock level test that ETF ownership causes excessive comovement in return comovement.

First, I measure the relationship between several measures of ETF activity and beta, which is the measure of comovement. Beta is calculated as the coefficient of excess monthly stock return and excess monthly market return. Market return is constructed from a value weighted portfolio of shares included in the OMX Nordic 120 index. I also add index fund and hedge fund ownership to control for other forms of institutional

ownership. Other controlling variables included logged market capitalization, trading volume, and book to market ratio.

Second, I measure if the price movement is excessive. This is measured by lagged market betas over time horizons, t-1, t-2, t-10 and t-30 days. If the movement would be excessive, the movement would revert over time.

3.2.4 ETF ownership and excess returns

The study by Ben-David et al. (2018) concluded that a potential implication of ETFs effect on stock volatility is that ETF ownership introduces a new source of risk in the underlying shares. ETFs invest across all stocks and therefore the risk caused by ETFs is not necessarily diversifiable. A natural question then arose, that if stocks owned by ETFs pay a premium to compensate for the additional risk. Even though it was found that ETF-induced shocks cancel out over time because of mean reversion, investors may still require a reward for carrying this additional volatility.

In order to test whether higher ETF ownership induce a premium return, I conduct a similar study as Ben-David et al. (2018) to examine the relationship between ETF ownership and returns. I build a quantile regression based on ETF ownership percentage. In the regression low portfolio refers to 0.1 quantile; 2, 3 and 4 refer to 0.25, 0.5 and 0.75 respectively and high to 0.9. After allocating each company in each month into these five portfolios, I calculate the excess returns for each company in the previous month. The results of the of the regression is shown in Table 12, Panel A.

In Table 12, Panel B the raw returns of a high-minus-low ETF ownership portfolio and company specific alphas are presented. The dependent variable is constructed by building two portfolios based on ETF ownership percentage and by subtracting the returns of the low ETF ownership portfolio from the high ETF ownership portfolio. The high-minus-low ETF ownership portfolio is then regressed against company specific alphas. I calculate the alphas for all the companies for each month during 2009-2018 in the following way:

$$Alpha = R_i - R_f - beta \times (R_m - R_f), \tag{21}$$

where R_i is the return of the company during the month, R_f is the risk-free rate and R_m is the market return. Beta is calculated by dividing monthly company return by monthly market return.

In Figure 9, I have presented the development of average monthly alphas over the time frame. As the downward slope exhibits, alphas have decreased over time as ETF ownership has increased. These results are consistent with our assumption that ETF ownership would decrease the returns as the volatility decreases. Decreasing alphas may also

indicate that the market has become more efficient over time through improved information efficiency.

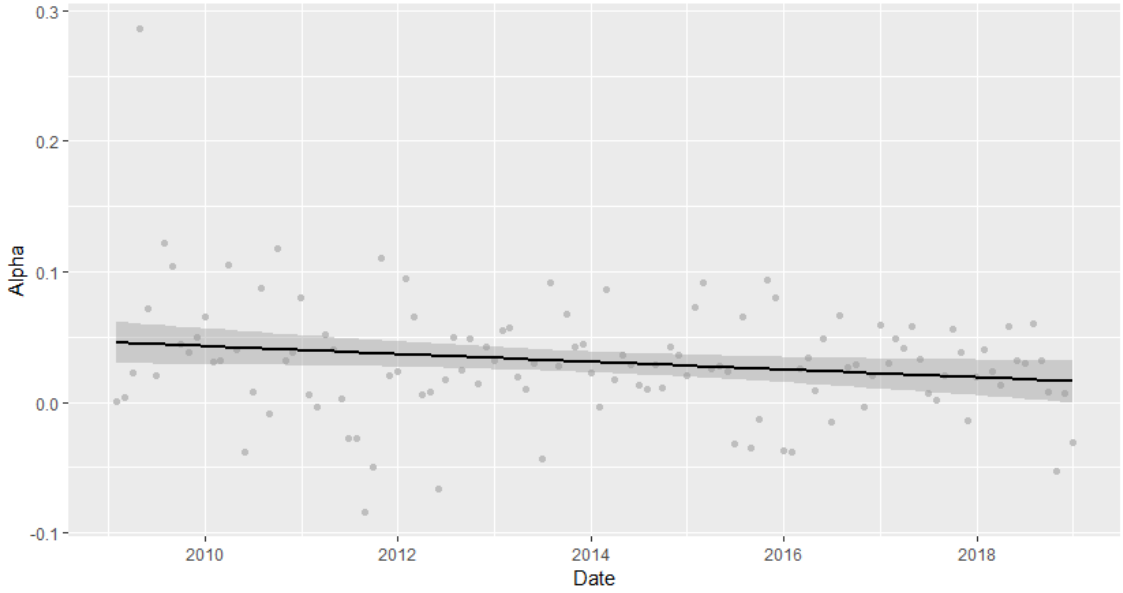

Figure 9 Development of alphas over time

Fama and French (2015) European five factors (MKTRF, HML, SMB, RMW, CMA) are used as controlling variables as well as momentum. Fama and French five factor estimates are retrieved from the Fama/French data library for each month from January 2009 to December 2018.

4 EMPIRICAL RESULTS

4.1 ETF ownership and share volatility

In this section, I am going to present the results of the main research question, how ETF ownership affects the volatility of underlying shares. I find evidence that supports neither the liquidity buffer hypothesis nor the price discovery hypothesis. In fact, ETF ownership is found to be negatively correlated with volatility and the relation is significant.

Similarly to the research made by Ben-David et al. (2018), I run a regression to measure the relationship between ETF ownership and daily stock volatility. The results shown in Table 3 suggest a completely opposite result from the study made by Ben-David et al. (2018). I find that ETF ownership is negatively and significantly correlated with daily stock volatility at 0.1% significance level. Since ETF ownership is included in the index fund ownership, and therefore are highly correlated with each other, index fund ownership is not significantly correlated with share volatility when ETF ownership is included in the regression. However, when ETF ownership is excluded from the regression, index fund ownership becomes significantly and negatively correlated with share volatility. The results suggest that all forms of institutional ownership included in the regression, ETF, index fund and hedge fund ownership, decrease volatility in the underlying shares. These findings suggest that institutional investors tend to absorb some of the illiquidity in the market causing the volatility to decrease in the underlying shares.

Both ETF turnover percentage and ETF ownership flow are also negatively correlated with daily stock volatility at a 5% significance level. In other words, ETF ownership level has the most significant effect on daily stock volatility. However, the regression including ETF ownership flow receives the highest R-squared level, indicating that it would be the best fitting model. The reason behind this result may come from the fact that ETF ownership level is already included in index fund ownership and is already taken into account in that variable.

In Table 5, the data has been split into subsamples. Columns 1-6 presents the same regression results as in Table 3, columns 12-14, but split into two time frames: 2009-2014 and 2015-2018. There seem to be some difference between the two time frames in ETF ownership indicating that the effect would have been slightly stronger in the earlier time frame. However, the difference in very small and no major conclusions can be made on it. In columns 7-10, the data has been split into four subsamples based on the level of ETF ownership. Bottom 25% presents the companies that have the smallest ETF ownership and top 25% presents the companies with the highest ETF ownership respectively. Bottom 50% and top 50% presents the top and bottom half of the companies based on ETF ownership. The results contain some ambiguity. Top and bottom 50% indicate that the

negative correlation would be stronger among companies with higher ETF ownership whereas top and bottom 25% indicate the opposite. It seems that the ETFs have a non-linear effect on volatility. To a certain point of ETF ownership, ETFs tend to decrease volatility which after the effect dampens. Perhaps, when ETF ownership is high enough, the liquidity provision effect is less steep, but otherwise the rise in ETF ownership makes the effect stronger. This result would be in line with the findings by Agarwal (2007) who found that institutional ownership adds liquidity in the shares up to a certain point but declines after that.

In Table 6, the same data has been divided into subsamples based on market capitalization. Top 25% presents the regression using data from the largest companies based on market capitalization and bottom 25% presents the smallest companies respectively. The results show clearly that that the liquidity buffer effect seem to be much larger for companies with higher market capitalization and smaller for companies with smaller market capitalization. Further, the effect was found to be similar when dividing the companies based on the liquidity of their share. Companies with high liquidity were affected more by the liquidity buffer caused by ETF ownership than companies with low liquidity.

Differing from the findings made by Ben-David et al. (2018), instead of ETF ownership increasing volatility, it seems to decrease share volatility in the Nordic markets. It seems to have the same effect that other forms of institutional investors have on the shares. Instead of adding risk to the market, ETFs take away risk from the market, perhaps by providing liquidity. Compared to the US market, the Nordic market is highly illiquid due to being relatively undeveloped. The Nordic market may even be so illiquid that price efficiency is affected by it and normal level of trading activity may push prices from their fundamental value and consequently add volatility.

Based on these findings we can reject the liquidity trading and price discovery hypotheses. The findings suggest that ETFs may add liquidity into the underlying shares making them more efficient and consequently decrease volatility. Similar findings have been made when studying the impact of institutional ownership on share liquidity.

Ownership structure and institutional ownership have been widely studied subject and researchers often concentrate on two alternative hypotheses: adverse selection hypothesis and trading hypothesis. (Rubin and Smith, 2009.) Adverse selection hypothesis suggests that the presence of more informed investors cause information asymmetry resulting in share illiquidity (Copeland and Galai, 1983; Easley and O'Hara, 1987; Glosten and Milgrom, 1985; Grossman and Stiglitz, 1980; Kyle, 1985). Trading hypothesis on the other hand suggests that competition among informed traders reduce information risk and

Table 4

ETF ownership and daily stock volatility

This table presents the stock/month panel regression measuring the effect of ETF ownership of a stock included in the OMX Nordic 120 on its volatility. *Share volatility* is calculated as the average daily volatility of each share during the month. *ETF ownership* is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. *ETF turnover* is the weighted turnover of ETF's holding of the share. *ETF ownership flow* is the change in ETF ownership in the share each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's logged market capitalization on the last day of each month. *Volume* is the average daily trading volume of each share during the previous month. *Gross profitability* is calculated as Novy-Marx (2013). *1/Price* is the inverse share price during the last day of the month. *12-month return* is the return of the stock during the previous year. *Book to Market* is the book to market ratio of each company on the last day of each month. Amihud ratio is calculated as Amihud (2002). Bid-ask-spread is calculated as the average bid-ask-spread of a stock during the previous month. *Skewness* is the average daily skewness of each share during the previous month. Heteroscedasticity- and autocorrelation-consistent standard errors are presented in Appendix A, Table 133. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels. R-squared excludes the explanatory power of fixed effects. The sample is collected from 2009 to 2018.

Dependent variable	Volatility														
Sample	OMX Nordic 120														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
ETF ownership	-0.043***			-0.048***	-0.074***	-0.073***	-0.073***	-0.073***	-0.073***	-0.071***	-0.071***	-0.071***			-0.071***
	(0.007)			(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)			(0.007)
ETF turnover													-0.000*		
													(0.000)		
ETF ownership flow														-0.001*	
														(0.001)	
Index fund ownership		-0.000		0.005	0.003	0.001	0.002	0.002	0.002	0.002	0.002	0.002	-0.007.	-0.012**	0.002
		(0.004)		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Hedge fund ownership			-0.021*	-0.033***	-0.030***	-0.033***	-0.029***	-0.028**	-0.028**	-0.024**	-0.025**	-0.025**	-0.024**	-0.034***	-0.026**
			(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.000)	(0.009)	(0.009)
Log(Market Cap EUR)				-0.006***	-0.004***	-0.004***	-0.003***	-0.003***	-0.003***	-0.002***	-0.002***	-0.002***	-0.002***	-0.034***	-0.002***
				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Volume					0.272***	0.273***	0.270***	0.271***	0.271***	0.274***	0.271***	0.271***	0.247***	0.253***	0.271***
					(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.014)
Bid-Ask Spread						0.066***	0.040*	0.041*	0.042*	0.035.	0.038*	0.038*	0.029	0.088***	0.038*
						(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.018)

ETF ownership and daily stock volatility - continued

1/Price							0.010***	0.010***	0.010***	0.006***	0.006***	0.006***	0.006***	-0.001	0.006***
							(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
12 month return								-0.000*	-0.000*	-0.000	-0.000.	-0.000*	-0.000.	-0.000	-0.000*
								(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Amihud ratio									-0.000	-0.000.	-0.000.	-0.000.	-0.000*	0.000***	-0.000.
									(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Book to Market										0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
										(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Gross profitability											-0.004***	-0.004***	-0.003***	-0.001.	-0.004***
											(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Skewness												0.000***	0.000***	0.000**	0.000***
												(0.000)	(0.000)	(0.000)	(0.000)
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Company fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Number of observations	11,278	11,278	11,278	11,278	11,278	11,278	11,278	11,278	11,278	11,278	11,278	11,277	11,277	11,037	11,277
R-squared	0.0032	0.0000	0.0005	0.0243	0.0551	0.0563	0.0658	0.0663	0.0663	0.0713	0.0730	0.0741	0.0668	0.0800	0.0741
Adjusted R-squared	-0.0166	-0.0199	-0.0194	0.0046	0.0360	0.0371	0.0468	0.0471	0.0471	0.0521	0.0537	0.0548	0.0473	0.060	0.0548

Table 5

Subsamples - Split time and ETF ownership

This table presents the stock/month panel regression measuring the effect of ETF ownership of a stock included in the OMX Nordic 120 on its volatility divided into subsamples based on time frame (columns 1-6) and ETF ownership (columns 7-10). Top 25% indicates the top quartile regarding ETF ownership and bottom 25% indicates bottom quartile respectively. *Share volatility* is calculated as the average daily volatility of each share in the previous month. *ETF ownership* is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. *ETF turnover* is the weighted turnover of ETF's holding of the share. *ETF ownership flow* is the change in ETF ownership in the share each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's market capitalization on the last day of each month. *Volume* is the average daily trading volume of each share during the previous month. *Gross profitability* is calculated as Novy-Marx (2013). *1/Price* is the inverse share price during the last day of the month. *12-month return* is the return of the stock during the previous year. *Book to Market* is the book to market ratio of each company on the last day of each month. *Amihud ratio* is calculated as Amihud (2002). *Bid-ask-spread* is calculated as the average bid-ask-spread of a stock during the previous month. *Skewness* is the average daily skewness of each share during the previous month. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels. R-squared excludes the explanatory power of fixed effects.

Dependent variable	Volatility									
Sample	OMX Nordic 120									
	2009-2013	2014-2018	2009-2013	2014-2018	2009-2013	2014-2018	Bottom 25%	Bottom 50%	Top 50%	Top 25%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ETF ownership	-0.057***	-0.053***					-0.066***	-0.078***	-0.082***	-0.037**
	(0.014)	(0.010)					(0.020)	(0.016)	(0.008)	(0.013)
ETF turnover			-0.000	-0.000*						
			(0.000)	(0.000)						
ETF ownership flow					-0.002*	-0.000				
					(0.001)	(0.001)				
Index fund ownership	0.009	-0.002	0.006	0.008	0.004	-0.110.	-0.044**	0.007	0.008	0.005
	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)	(0.014)	(0.009)	(0.005)	(0.005)
Hedge fund ownership	-0.040**	-0.046*	-0.038**	-0.045*	-0.042***	-0.049*	-0.108***	0.010	-0.035***	-0.003
	(0.013)	(0.022)	(0.013)	(0.022)	(0.013)	(0.022)	(0.032)	(0.020)	(0.009)	(0.011)
Log(Market Cap EUR)	-0.006***	-0.001	-0.006***	-0.001	-0.006***	-0.002.	0.005***	0.002***	-0.004***	-0.002.
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Volume	0.335***	0.439***	0.329***	0.396***	0.348***	0.462***	0.072***	0.123***	0.635***	1.445***
	(0.019)	(0.031)	(0.019)	(0.030)	(0.024)	(0.032)	(0.020)	(0.018)	(0.025)	(0.052)
Bid-Ask Spread	0.036	-0.082	0.032	-0.074	0.084**	-0.069	0.068*	0.041*	0.018	0.583***
	(0.024)	(0.123)	(0.024)	(0.124)	(0.026)	(0.137)	(0.034)	(0.020)	(0.060)	(0.159)

Subsamples - continued

1/Price	0.008***	-0.023*	0.008***	-0.027**	-0.001	-0.020*	0.008***	0.007***	-0.041***	-0.034***
	(0.002)	(0.009)	(0.002)	(0.009)	(0.002)	(0.010)	(0.001)	(0.001)	(0.005)	(0.006)
12 month return	-0.000.	-0.000	-0.000.	-0.000	-0.000	-0.000	0.000	0.000	-0.001***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Amihud ratio	-0.000	0.001***	-0.000	0.001***	0.000**	0.001**	-0.000	-0.000	0.015***	0.014***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Book to Market	0.000	0.003***	0.000	0.003***	0.002***	0.003***	0.001***	0.002***	0.002***	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)	(0.000)	(0.000)	(0.000)	(0.001)
Gross profitability	-0.004**	0.002	-0.004**	0.002	-0.002.	0.002	0.000	-0.002*	-0.003*	-0.005**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Skewness	0.001***	-0.000*	0.001***	-0.000*	0.001***	-0.000.	0.001***	0.000***	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Company fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	5,482	5,795	5,482	5,795	5,296	5,741	2,571	5,401	5,756	2,919
R-squared	0.1187	0.0503	0.1161	0.0459	0.1168	0.0532	0.0837	0.0489	0.1810	0.2954
Adjusted R-squared	0.0918	0.0214	0.0891	0.0169	0.0891	0.0242	0.0760	0.0161	0.1546	0.2558

Table 6

Subsamples – Market capitalization

This table presents the stock/month panel regression measuring the effect of ETF ownership of a stock included in the OMX Nordic 120 on its volatility divided into subsamples based on each shares market capitalization. Top 25% indicates the top quartile regarding market capitalization and bottom 25% bottom quartile respectively. *Share volatility* is calculated as the average daily volatility of each share in the previous month. ETF ownership is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's market capitalization on the last day of each month. *Volume* is the average daily trading volume of each share during the previous month. *Gross profitability* is calculated as Novy-Marx (2013). *1/Price* is the inverse share price during the last day of the month. 12-month return is the return of the stock during the previous year. *Book to Market* is the book to market ratio of each company on the last day of each month. *Amihud ratio* is calculated as Amihud (2002). *Bid-ask-spread* is calculated as the average bid-ask-spread of a stock during the previous month. *Skewness* is the average daily skewness of each share during the previous month. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels. R-squared excludes the explanatory power of fixed effects.

Dependent variable	Volatility			
	Bottom 25%	Bottom 50%	Top 50%	Top 25%
	(1)	(2)	(3)	(4)
ETF ownership	-0.035***	-0.047***	-0.179***	-0.246***
	(0.010)	(0.009)	(0.015)	(0.020)
Index fund ownership	-0.007	-0.007	0.002**	-0.006
	(0.007)	(0.006)	(0.006)	(0.010)
Hedge fund ownership	0.021	-0.004	-0.036***	-0.031*
	(0.023)	(0.015)	(0.010)	(0.015)
Log(Market Cap EUR)	0.002*	0.001.	-0.005***	-0.004**
	(0.001)	(0.001)	(0.001)	(0.001)
Volume	0.197***	0.195***	0.824***	0.660***
	(0.028)	(0.016)	(0.035)	(0.052)
Bid-Ask Spread	0.062*	0.029	0.164***	0.764***
	(0.024)	(0.022)	(0.036)	(0.193)
1/Price	-0.002	-0.006***	-0.065**	0.108.
	(0.003)	(0.002)	(0.022)	(0.056)
12 month return	-0.000	-0.000	-0.001**	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Amihud ratio	0.000.	0.001***	-0.000	0.006***
	(0.000)	(0.000)	(0.000)	(0.001)
Book to Market	0.004***	0.005***	0.001**	0.004***
	(0.001)	(0.000)	(0.000)	(0.001)
Gross profitability	-0.003	-0.006***	-0.000	0.002
	(0.002)	(0.001)	(0.001)	(0.001)
Skewness	0.000***	0.000**	0.002**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Month fixed effects	Yes	Yes	Yes	Yes
Company fixed effects	Yes	Yes	Yes	Yes
Number of observations	2,673	5,710	5,567	2,584
R-squared	0.1273	0.0962	0.1344	0.2632
Adjusted R-squared	0.0734	0.0667	0.1054	0.2162

leads to improved information efficiency reducing transaction costs which helps share liquidity (Admati and Pfleiderer, 1988; Agarwal, 2007; Foster and Viswanathan, 1996; Holden and Subrahmanyam, 1992; Subrahmanyam, 1991). In this case the trading hypotheses seems more like probable alternative to explain the decreased volatility.

In the following section I am going to take the trading hypothesis into further inspection, and I will study the effect of ETF ownership on liquidity of the underlying shares.

4.2 ETF ownership and share liquidity

In the previous section, I found that in the Nordic market, ETF ownership is positively correlated with daily stock volatility, meaning that ETFs make the underlying shares less risky. Based on the findings made in the previous section, I am going to further test the trading hypothesis that ETFs act as liquidity providers in the Nordic market and add competition to the market and through that make it more efficient.

Even though Hamm (2010) found a positive relationship between the percentage of firm shares being held by ETFs and illiquidity in the market for the underlying stock, based on the findings made in the previous section, I would predict the opposite. The new hypothesis would predict added trading volume followed by improved liquidity.

In Table 7, I have presented the panel regression on the effect of ETF ownership on stock trading volume. ETF ownership was found to be significantly and positively correlated with trading volume at 0.1% significance level, indicating that an increase in ETF ownership leads to more trading. This finding is consistent with the findings of Ben-David et al. (2018). In an illiquid market, which the Nordic market is often considered to be, this would be a positive effect since more trading could perhaps lead to a more efficient market. Index funds are showing a similar affect that ETFs are but surprisingly hedge funds seem to lessen trading volume as it is negatively correlated with trading volume, even though hedge funds are usually considered to be of high frequency trading.

In Table 8, the effect of ETF ownership on bid-ask-spread is presented. ETF ownership was found to be positively and significantly correlated with bid-ask-spread at 0.1% significance level, meaning that the transaction costs increase with ETF ownership i.e. becomes more illiquid. However, ETF turnover seems to have an opposite effect, reducing the bid-ask-spread. When calculating the heteroscedastic and autocorrelation consistent standard errors, the relationship between ETF ownership and bid-ask-spread is not significantly correlated anymore, but the negative correlation between ETF turnover and bid-ask-spread still remains at 1% significance level. Therefore, we can conclude that at least ETF turnover has a positive effect on liquidity by decreasing the transaction cost through bid-ask-spread.

Table 7

ETF ownership and trading volume

This table presents the stock/month panel regression measuring the effect of ETF ownership of a stock included in the OMX Nordic 120 on its trading volume. *Trading volume* is calculated as the average daily shares traded divided by shares outstanding during the previous month. *ETF ownership* is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. *ETF turnover* is the weighted turnover of ETF's holding of the share. ETF ownership flow is the change in ETF ownership in the share each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's market capitalization on the last day of each month. *Gross profitability* is calculated as Novy-Marx (2013). *12-month return* is the return of the stock during the previous year. *Book to Market* is the book to market ratio of each company on the last day of each month. *Amihud ratio* is calculated as Amihud (2002). *Bid-ask-spread* is calculated as the average bid-ask-spread of a stock during the previous month. Heteroscedasticity- and autocorrelation-consistent standard errors are presented in Appendix A, Table 14. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels. R-squared excludes the explanatory power of fixed effects.

Dependent Variable:	Trading volume										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
ETF ownership	0.099***	0.095***	0.095***	0.094***	0.093***	0.093***	0.092***	0.093***	0.093***		
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)		
ETF turnover										0.000	
										(0.000)	
ETF flow											0.000
											(0.000)
Index fund ownership		0.008**	0.008**	0.006*	0.006*	0.006*	0.006*	0.006*	0.007*	0.020***	0.021***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Hedge fund ownership			-0.003	-0.012*	-0.013*	-0.015**	-0.016**	-0.016**	-0.014*	-0.017**	-0.017**
			(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)
Log(Market Cap)				-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.004***
				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Gross profitability					-0.003**	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***
					(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
12-month return						0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
						(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

ETF ownership and trading volume - continued

Book-to-Market ratio							-0.000*	-0.000	-0.000	-0.000*	0.000
							(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Amihud ratio								-0.000***	-0.000***	-0.000***	-0.000***
								(0.000)	(0.000)	(0.000)	(0.000)
Bid-ask-spread									-0.023.	-0.015	-0.008
									(0.012)	(0.012)	(0.012)
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	11,278	11,278	11,278	11,278	11,278	11,278	11,278	11,278	11,278	11,278	11,037
R-squared	0.0369	0.0376	0.0376	0.0705	0.0731	0.07528	0.0758	0.0783	0.0786	0.0482	0.0477
Adjusted R-squared	0.0177	0.0183	0.0183	0.0517	0.0544	0.0564	0.0569	0.0593	0.0595	0.0286	0.0276

Table 8

ETF ownership and bid-ask-spread

This table presents the stock/month panel regression measuring the effect of ETF ownership of a stock included in the OMX Nordic 120 on its bid-ask-spread. *Bid-ask-spread* is calculated as the average bid-ask-spread of a stock during the previous month. *ETF ownership* is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. ETF turnover is the weighted turnover of ETF's holding of the share. *ETF ownership flow* is the change in ETF ownership in the share each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's market capitalization on the last day of each month. *1/Price* is the inverse share price during the last day of the month. *12-month return* is the return of the stock during the previous year. *Book to Market* is the book to market ratio of each company on the last day of each month. *Free float* is the percentage of shares available for trading in the market on the last day of the month. Heteroscedasticity- and autocorrelation-consistent standard errors are presented in Appendix A, Table 15. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels. R-squared excludes the explanatory power of fixed effects.

Dependent variable:	Bid-ask-spread									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ETF ownership	0.022***	0.007.	0.008*	0.011**	0.012**	0.013**	0.013***	0.013***		
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)		
ETF turnover									-0.0002***	
									(0.000)	
ETF flow										-0.000
										(0.000)
Index fund ownership		0.031***	0.029***	0.027***	0.027***	0.027***	0.027***	0.027***	0.029***	0.029***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Hedge fund ownership			0.066***	0.052***	0.054***	0.054***	0.055***	0.055***	0.054***	0.060***
			(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Log(Market cap)				-0.004***	-0.004***	-0.004***	-0.004***	-0.003***	-0.003***	-0.002***
				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1/Price					0.007***	0.007***	0.005***	0.005***	0.005***	0.006***
					(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

ETF ownership and bid-as-spread – continued

12-month return						0.000**	0.000***	0.000***	0.000**	0.000***
						(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Book-to-market ratio							0.001***	0.001***	0.001***	0.000***
							(0.000)	(0.000)	(0.000)	(0.000)
Free float %								0.000	0.000	-0.000
								0.000	0.000	0.000
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Company fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	12,119	12,119	12,119	11,278	11,278	11,278	11,278	11,278	11.278	11,037
R-squared	0.0029	0.0195	0.0371	0.0793	0.0959	0.0965	0.0998	0.100	0.1010	0,0927
Adjusted R-squared	-0.0155	0.0013	0.0191	0.061	0.0776	0.0781	0.0814	0.0814	0.0826	0.0833

Table 9

ETF ownership and Amihud ratio

This table presents the stock/month panel regression measuring the relationship between ETF ownership and Amihud ratio (2002), a ratio measuring illiquidity. The dependent variable *Amihud ratio* is calculated as in Amihud (2002). *ETF ownership* is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. *ETF turnover* is the weighted turnover of ETF's holding of the share. *ETF ownership flow* is the change in ETF ownership in the share each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's market capitalization on the last day of each month. *Gross profitability* is calculated as Novy-Marx (2013). *12-month return* is the return of the stock during the previous year. *Book to Market* is the book to market ratio of each company on the last day of each month. *Trading volume* is calculated as the average daily shares traded divided by shares outstanding during the previous month. *Bid-ask-spread* is calculated as the average bid-ask-spread of a stock during the previous month. In columns 1-11 the data has been cleaned by removing outliers. Column 12 presents the same regression with the outliers included. Heteroscedasticity- and autocorrelation-consistent standard errors are presented in Appendix A, Table 16. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels. R-squared excludes the explanatory power of fixed effects.

Dependent Variable:	Amihud ratio											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ETF ownership	-0.599***	-0.637***	-0.635***	-0.652***	-0.648***	-0.650***	-0.580***	-0.305***	-0.310***			10.332.
	(0.043)	(0.044)	(0.044)	(0.041)	(0.041)	(0.041)	(0.040)	(0.039)	(0.038)			(5.350)
ETF turnover										-0.002**		
										(0.000)		
ETF flow											0.001	
											(0.003)	
Index fund ownership		0.098***	0.095***	0.046.	0.044.	0.046.	0.038	0.057**	0.042.	0.009	0.023	-1.623
		(0.026)	(0.026)	(0.023)	(0.024)	(0.024)	(0.023)	(0.022)	(0.022)	(0.022)	(0.021)	(2.995)
Hedge fund ownership			0.138**	0.004	0.009	0.018	0.057	0.010	-0.027	-0.022	-0.004	-6.787
			(0.050)	(0.046)	(0.046)	(0.046)	(0.045)	(0.043)	(0.043)	(0.043)	(0.043)	(6.156)
Log(Market Cap)				-0.089***	-0.089***	-0.089***	-0.077***	-0.095***	-0.093***	-0.093***	-0.090***	-1.309***
				(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.291)
Gross profitability					0.018***	0.017***	0.017***	0.012**	0.011**	0.012**	0.006	0.802
					(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.591)

ETF ownership and Amihud ratio – continued

12-month return						-0.003*	0.000	0.002.	0.002.	0.002*	0.002***	0.264*
						(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.126)
Book-to-Market ratio							0.028***	0.029***	0.028***	0.029***	0.029***	2.409***
							(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.123)
Trading volume								-2.731***	-2.736***	-2.860***	-3.262***	-54.290***
								(0.077)	(0.077)	(0.075)	(0.082)	(10.268)
Bid-ask-spread									0.611***	0.572***	0.483***	90.309***
									(0.104)	(0.105)	(0.110)	(13.094)
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	9,909	9,909	9,909	9,909	9,909	9,909	9,909	9,909	9,909	9,909	9,832	11,278
R-squared	0.0196	0.0211	0.0219	0.1612	0.1626	0.1632	0.1978	0.2906	0.2931	0.2892	0.2910	0.0555
Adjusted R-squared	-0.0025	-0.0010	-0.0003	0.1421	0.1434	0.1439	0.1793	0.2742	0.2766	0.2725	0.2743	0.0360

Finally, we regress the ETF ownership against Amihud ratio (Amihud, 2002), a frequently used illiquidity measure. The result of this regression is presented in Table 9. The first results indicated that there would be no significant correlation between the Amihud ratio and ETF ownership. However, I find that the data included some significant outliers. While the median Amihud ration in the data was 0.038, there were a few ratios that exceeded 300, due to exceptionally low trading volume on certain days. The removal of outliers in R is presented in the Appendix C. After removing the outliers, ETF ownership was found to be significantly and negatively correlated with Amihud ratio at a 0.1% significance level, suggesting that ETF ownership improves liquidity. In addition, ETF turnover percentage seems to have the same effect having a negative correlation with Amihud ratio at a 1% significance level.

The overall result of this section is that ETF ownership seems to add trading volume and it decreases Amihud ratio, i.e. make the shares more liquid. These finding support previous findings in this study suggesting that ETF ownership decreases daily share volatility. In addition, the results seem to be consistent with the trading hypothesis. As more informed investors are trading in the market, the more efficient the equity market becomes improving liquidity. In both US and Nordic market, ETFs add a new layer of trading to the stock market, but the effect that the added trading has on the shares is different. As the Nordic market is less liquid, the fact that ETFs bring more informed investors to the market, result in more competition and better information efficiency in the market.

4.3 ETF ownership and return comovement

Da and Shive (2015) found evidence supporting that arbitrageurs can contribute to return comovement via ETF arbitrage. The link was found both on stock and fund level and the effect was stronger among small and illiquid stocks. To study the same effect on the Nordic market, I replicate on main parts the stock-level study conducted by Da and Shive (2015) to reach comparable results. I use regression to estimate the effect of different forms of ETF activities on beta, the coefficient of the stock's daily excess return on the daily market excess return.

The results suggest that ETF ownership is negatively correlated with stock return comovement in the Nordic markets at a 0.1% significance level. This result is in contrast to the ones reported by Da and Shive (2015). In the Nordic market the level of ETF ownership seems to decrease return comovement whereas in the US market it adds to return comovement.

If ETF ownership is negatively related to return comovement, it raises a question of if the decrease in ETF comovement if due to improved information efficiency and reflects a faster incorporation of information or does it contain excessive price movement. If the

price movement would be excessive, the price movements would reverse over time. In order to examine this effect, I use the stock's lagged betas. The results are presented in Table 11 and it seems that the price movement caused by ETFs is not excessive. There seems to be no reversal during the thirty days that the betas have been lagged.

Again, the results from the Nordic market is not consistent with the one's reported from the US market. Da and Shive (2015) reported excessive comovement that would revert within two days whereas results given in this study suggests decreased comovement with no reversal.

Table 10

ETF ownership and return comovement

This table presents the month/stock panel regression relating measures of a stock's exposure to ETF activities a measure of its comovement with the market portfolio. *Beta* is the coefficient of the stock's daily excess return on daily market excess return in that month. *ETF ownership* is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. *ETF turnover* is the weighted turnover of ETF's holding of the share. *ETF ownership flow* is the change in ETF ownership in the share each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's market capitalization on the last day of each month. *Book to Market* is the book to market ratio of each company on the last day of each month. Heteroscedasticity- and autocorrelation-consistent standard errors are presented in Appendix A, Table 17. The dependent variable and ownership variables are standardized by subtracting the mean and dividing by its standard deviation. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels. R-squared excludes the explanatory power of fixed effects. The sample covers the period January 2009 to December 2018.

Dependent variable:	β_M							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETF ownership	-0.087***	-0.098***	-0.098***	-0.106***	-0.105***	-0.105***		
	(0.013)	(0.014)	(0.014)	(0.013)	(0.014)	(0.014)		
ETF turnover							-0.010	
							(0.009)	
ETF ownership flow								-0.009
								(0.008)
Index fund ownership		0.056**	0.057**	0.049**	0.049**	0.050**	0.016	0.011
		(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)	(0.017)
Hedge fund ownership			-0.004	0.000	0.000	0.001	0.003	-0.002
			(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Log(Market Cap)				-0.403***	-0.399***	-0.448***	-0.430***	-0.286***
				(0.051)	(0.052)	(0.055)	(0.055)	(0.058)
Volume					0.787	0.609	2.310	3.723.
					(2.001)	(2.002)	(1.994)	(2.078)
Book to Market						-0.066**	-0.070**	-0.058*
						(0.024)	(0.024)	(0.024)
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Company fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	11,278	11,278	11,278	10,856	10,856	10,856	10,857	10,637
R-squared	0.0038	0.0046	0.0046	0.0111	0.0112	0.0119	0.0064	0.0033

Table 11

Comovement with lagged betas

This table presents the month/stock panel regression relating measures of a stock's exposure to ETF activities a measure of its comovement with the market portfolio. *Beta* is the coefficient of the stock's daily excess return on daily market excess return in that month. *ETF ownership* is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. *ETF turnover* is the weighted turnover of ETF's holding of the share. *ETF ownership flow* is the change in ETF ownership in the share each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's market capitalization on the last day of each month. *Book to Market* is the book to market ratio of each company on the last day of each month. The dependent variable and ownership variables are standardized by subtracting the mean and dividing by its standard deviation. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels. R-squared excludes the explanatory power of fixed effects. The sample covers the period January 2009 to December 2018.

Dependent variable:	$\beta_{M_{t-1}}$	$\beta_{M_{t-2}}$	$\beta_{M_{t-10}}$	$\beta_{M_{t-30}}$
	(1)	(2)	(3)	(4)
ETF ownership	-0.102***	-0.103***	-0.107***	-0.101***
	(0.014)	(0.014)	(0.014)	(0.014)
Index fund ownership	0.044**	0.047**	0.040*	0.049**
	(0.018)	(0.018)	(0.018)	(0.018)
Hedge fund ownership	0.001	-0.002	-0.003	0.014
	(0.010)	(0.010)	(0.010)	(0.010)
Log(Market Cap)	-0.445***	-0.451***	-0.519***	-0.464***
	(0.055)	(0.055)	(0.055)	(0.056)
Volume	0.137	-0.042	-2.379	-0.893
	(2.021)	(2.013)	(2.020)	(2.022)
Book to Market	-0.066**	-0.069**	-0.066**	-0.101***
	(0.024)	(0.024)	(0.024)	(0.024)
Month fixed effects	Yes	Yes	Yes	Yes
Company fixed effects	Yes	Yes	Yes	Yes
Number of observations	10,856	10,856	10,856	10,856
R-squared	0.0112	0.0112	0.0134	0.0118

4.4 ETF ownership and excess returns

Studies researching the effect of ETF ownership have concluded that if ETF ownership in shares tend to add volatility in them, and shareholders should require a premium for the risk that they bear, even if it was only temporary. Ben-David et al. (2018) found a significant positive relationship between ETF ownership and excess returns confirming this assumption. Since this study found ETF ownership to decrease the volatility in the underlying shares, it would be logical that the return of shares that have a wide ETF ownership base would be smaller because of the decreased risk.

The results are, as assumed, the complete opposite from the ones by Ben-David et al. (2018). For all quantiles, monthly excess returns are all negatively correlated with ETF ownership. All portfolios except the low quantile is significantly correlated at a 0.1%

significance level. In addition, the negative correlation in monthly excess return seem to be steeper for shares with a more significant ETF ownership.

Based on these results, it seems that instead of shareholders requiring a premium on their investment, shares with higher ETF ownership are considered to be less risky and therefore the requirement for a premium diminish. However, this correlation does not count for any controlling variables such as company size. As already stated earlier, company market capitalization is highly correlated with ETF ownership and therefore companies with a high ETF ownership may be larger and more established and would require a smaller premium due to the safety that the company size provides.

To further study the impact of ETF ownership on the excess returns of the underlying shares, in Table 12, Panel B I run a regression for the high-minus-low ETF ownership portfolio. The dependent variable is constructed by building two portfolios based on ETF ownership percentage and by subtracting the returns of the low ETF ownership portfolio from the high ETF ownership portfolio. In Panel B, alpha seems to be highly negatively and significantly correlated with the high-minus-low portfolio. Introducing the Fama and French (1997) three factor model (MKTRF, SMB and HML) does not change the impact of alpha. Adding the Fama and French (2015) five factor model's two factors (RMW, CMA), no significant changes appear.

Table 12

ETF ownership and returns

Panel A presents five quantile portfolios constructed based on the level of ETF ownership in the company. *Monthly excess return* has been calculated for each portfolio equally weighted. Panel B presents the return of a high-minus-low ETF ownership portfolio on *alpha*. The factors are the five factors (*MRKRF, SMB, HML, RMW, CMA*) from Fama & French (2015, Europe) and *momentum*. Heteroscedasticity- and autocorrelation-consistent standard errors are presented in Appendix A, Table 18. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels.

Panel A: Excess Returns for the Quantile Portfolios

	Quantiles Based on ETF ownership				
	Low	(2)	(3)	(4)	High
Monthly excess returns	-0.001	-0.005***	-0.009***	-0.010**	-0.013**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.010)
Number of months	120	120	120	120	120

Panel B: High-Minus-Low Portfolio, Full Sample

Dependent Variable:	Return(High-Minus-Low ETF Ownership)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Alpha	-0.242***	-0.225***	-0.200***	-0.214***	-0.213***	-0.197***	-0.208***
	(0.033)	(0.050)	(0.047)	(0.047)	(0.047)	(0.049)	(0.052)
MKTRF		-0.019	-0.056	-0.006	-0.007	-0.001	0.006
		(0.043)	(0.042)	(0.047)	(0.047)	(0.047)	(0.048)

Panel B – continued

SMB			-0.322***	-0.311***	-0.317***	-0.303***	-0.287**
			(0.084)	(0.083)	(0.085)	(0.086)	(0.089)
HML				-0.152	-0.182	-0.233.	-0.251*
				(0.068)	(0.113)	(0.120)	(0.124)
RMW					-0.054	0.044	-0.072
					(0.161)	(0.161)	(0.167)
CMA						0.177	0.185
						(0.145)	(0.146)
Momentum							0.000
							(0.001)
Number of months	120	120	120	120	120	120	120
R-squared	0.3078	0.3090	0.3861	0.4118	0.4124	0.4200	0.4222
Adjusted R-squared	0.3020	0.2972	0.3702	0.3913	0.3866	0.3892	0.3861

The results are consistent with the outcome of the correlation between ETF ownership and volatility. As ETF ownership decreases the volatility in the underlying shares, the amount of risk also decreases resulting in lower excess return. As the share is less risky, shareholders decrease their demand for a premium based on this risk. Alphas therefore decrease significantly as ETF ownership increases making the market more stable.

However, the results are again in contrast with previous empirical studies made on the subject. As Ben-David et al. (2018) stated, ETFs do significantly modify the underlying stock's returns distribution, but in this case the direction of this modification is the opposite. In the Nordics, ETFs do not seem to impound a new source of non-diversifiable risk into the underlying shares but on the contrary, they seem to reduce non-diversifiable risk.

4.5 Robustness

In this section the robustness of this study is going to be discussed. A coefficient test has been conducted in order to receive heteroscedasticity and autocorrelation consistent coefficients for each core regression in this study. The heteroscedasticity and autocorrelation consistent coefficients did not alter the results in any meaningful way. The tables for the heteroscedasticity and autocorrelation consistent coefficients are presented in Appendix D.

For the main regression and research question, on how ETF ownership in shares affect the volatility of the underlying shares, I have performed regressions with several subsamples and reached the same results; ETF ownership reduces volatility in the underlying shares. Some variation occurred in the magnitude of the effect when dividing the sample into subsamples, but the overall result did not change. The effect of ETFs on volatility

seemed to be slightly stronger during 2009-2013 than 2014-2018 but difference was more or less trivial. However, when dividing the data into annual subsamples (Appendix B, Table 19), only 5 out of 10 years were statistically significant regarding the relation between ETF ownership and daily stock volatility. Those years that the correlation was significant, the effect was negative, i.e. ETF ownership decreases volatility.

The data was also divided into subsamples based on their industry classification which was retrieved from Thomson Reuters Eikon. A table of the industry classifications are shown in Appendix B, Table 21. Several industry subsets were relatively small in terms of number of observations and therefore adjusted R-squared shifted to negative. However, in all of the cases that adjusted R-squared was positive, ETF ownership was negatively and significantly correlated with volatility. The largest impact seemed to be in the real estate, rental and leasing sector. In addition, the manufacturing, and finance and insurance sector was found to be affected by ETF ownership. The results of the regressions on the industry subsamples are presented in Appendix B, Table 20.

ETF ownership level subsamples showed a non-linear relationship between ETF ownership and stock volatility, but the direction of the effect remained constant. Because the non-linear relationship, another method should have been used to gain solid results of the correlation, but since the goal was to reach comparable results with Ben-David et al. (2018), regression analysis was used.

To test the possible non-linearity of the regression I construct two regressions for ETF ownership and daily stock volatility: a linear regression and a non-linear regression. The plotted regressions are presented in Figure 10 and Figure 11.

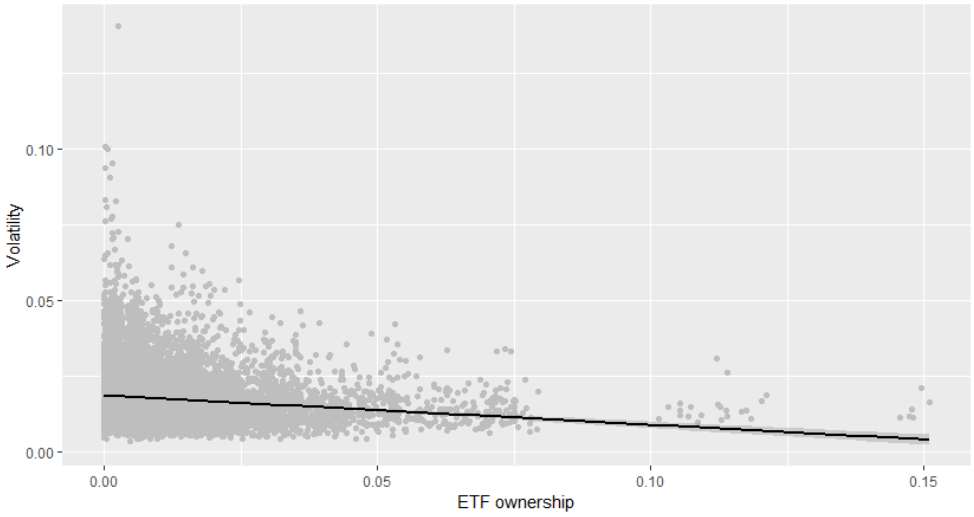

Figure 10 Linear regression for ETF ownership and daily stock volatility

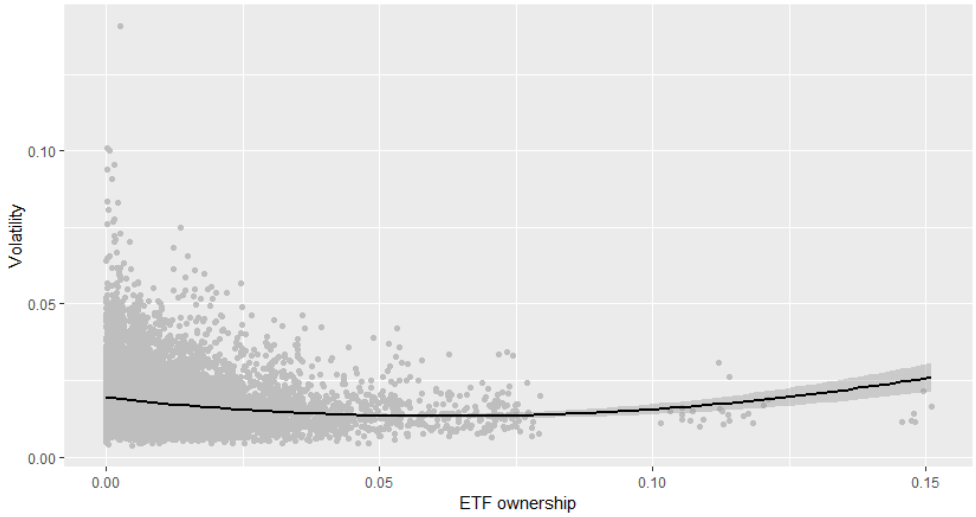

Figure 11 Non-linear regression for ETF ownership and daily stock volatility

Calculating the regressions, suggest that the non-linear regression is a better fitting model with an R-squared of 0.0318, whereas the linear regression has an R-squared of 0.0224. The linear regression was calculated as

$$Daily\ stock\ volatilitiy_{it} = \alpha + \beta \times ETF\ \widehat{ownership}_{it} + \varepsilon_{it}, \qquad (22)$$

and the non-linear regression as

$$\begin{aligned} Daily\ stock\ volatilitiy_{it} & \\ &= \alpha + \beta_1 \times ETF\ \widehat{ownership}_{it} \\ &+ \beta_2 \times ETF\ \widehat{ownership}_{it}^{\,2} + \varepsilon_{it}. \end{aligned} \qquad (23)$$

To control for other types of institutional ownership, I added index fund ownership and hedge fund ownership as controlling factors. Other institutional ownership did not alter the results. The heteroscedasticity and autocorrelation consistent coefficients shown in Table 13 are consistent with the results given earlier. ETF ownership remains negatively correlated at a 1% significance level.

When testing the effect of ETF ownership on share liquidity, I chose three different measures of liquidity and all of the regressions reached more or less the same results. ETF ownership level ceased to be significantly correlated with bid-ask-spread when performing the coefficient test, and this was taken into account in the interpretation of the results. In addition, it was noted that ETF ownership would not have been statistically significantly correlated with Amihud ratio if it wasn't for removal of outliers.

5 CONCLUSION AND SUMMARY

In this thesis I conduct an extensive study on the effect of exchange-traded funds (ETFs) on the volatility of the underlying shares. In addition, I provide supporting evidence for the results of the main research question by studying the effect of ETFs on share liquidity, return comovement and excess return. I extend the research of Ben-David et al. (2018) by studying the impact of ETFs on the Nordic market, a smaller and more illiquid market than the US. To the best of my knowledge, no previous studies have been made on the impact of ETFs in the Nordic market and the findings of this thesis are valuable to the academic and business world since it brings out completely new angles to the topic.

Exchange-traded funds have experienced a significant growth in terms of size and popularity due to the cost efficiencies and diversification benefits that they provide. In addition, ETFs provide access to more illiquid markets through their funds. Due to the abrupt rise of ETFs, academics and the regulators have paid more attention to the subject and found that ETFs may have a disruptive effect on the stock market. Ben-David et al. (2018) found that in the US ETFs cause excessive increase in volatility in the underlying shares due to their unique arbitrage process. In addition, ETFs appeared to introduce a new layer of undiversifiable risk into the underlying stock. Therefore, ETFs may have a dangerous destabilizing effect on the stock market. However, the existing literature nearly only focuses on the US market which is a highly accessible market.

To extend previous research made on the effect of ETFs, I conducted a study focusing on the Nordic market. Using the data from the OMX Nordic 120 index shares from January 2009 to December 2018, I run a regression to measure the impact of ETF ownership on daily stock volatility and I find that ETF ownership is significantly and negatively correlated with daily stock volatility. Instead of adding volatility, as first predicted, ETFs decrease volatility in the underlying stock. The effect was found to be even stronger among shares with higher market capitalization. In addition, there seemed to be a non-linear relationship between ETF ownership and volatility as the volatility decreasing effect dampened after a certain point of ETF ownership.

Since the results found did not follow the one's presented by Ben-David et al. (2018), a new hypothesis needed to be constructed. The most obvious differences between the US and the Nordic market is size and liquidity. Perhaps, instead of taking away liquidity from the underlying stock, ETFs act as liquidity providers for the stock market. Following previous studies on ownership structure, ETFs may bring new informed competition to the market making it more efficient. This effect is commonly known as the trading hypothesis.

To test the effect of ETFs on stock market efficiency and to extend our understanding on the reasons behind ETFs effect on volatility, I test the relationship between ETFs and three different measures on share liquidity: trading volume, bid-ask-spread and Amihud

ratio (Amihud, 2002). The findings were consistent with the trading hypothesis. As Ben-David et al. (2018) mentioned in their study, ETFs do add a new layer of trading in the underlying stock, also in the Nordic market. This was confirmed by running a regression measuring the relation between ETFs and stock trading volume. However, ETF fund flows were found to be negatively correlated with bid-ask-spread and ETF ownership was also found to be negatively correlated with Amihud ratio (Amihud, 2002), a commonly used illiquidity measure. Overall, ETFs seemed to add liquidity into the shares even though the arbitrage activity is commonly thought to absorb liquidity away from the shares. In the Nordic market, ETFs add trading which then extends to added stock liquidity making the market more efficient.

Another common assumption on ETFs, and moreover index investing in general, is that they add commonality in the underlying stock more than their fundamentals would suggest. This was found to be untrue in the Nordic market. I examined the relation between ETF ownership and return comovement of the underlying stock and concluded that ETFs decrease return comovement. I further studied if this effect would be excessive by regressing ETF ownership against lagged return comovement over several time horizons but found the effect to be consistent and does not experience reversal.

Finally, we study the effect of ETFs on stock returns. Ben-David et al. (2018) found that ETFs add a new source of risk to the underlying stock that cannot necessarily be diversified away since ETFs invest nearly across all stocks. The question was if investors require a premium for the added risk, even if the risk was only temporary. The answer was yes, investors do require a premium. Since ETFs reduce information risk in the Nordic market it would be logical to predict that investors would not require a premium but on the contrary. I replicated the test made by Ben-David et al. (2018) using Nordic data and found that ETF ownership reduce excess return. Again, the results are consistent with the trading hypothesis.

To sum, the results found in the Nordic market are significantly different than the ones found in the US market. In the Nordics, ETFs seem to act as liquidity providers adding trading and efficiency, and simultaneously reducing volatility, adding liquidity and decreasing overall risk by improving diversification chances. The one thing found to be similar in the US and Nordic market is that ETFs add trading. However, the effect that this added trading have on the stock market is different. As the Nordic market is less liquid, the fact that ETFs bring more informed investors to the market, result in more competition and better information efficiency in the market.

Since it was discovered that ETFs may have a non-linear relationship with ETFs, it cannot be confirmed that these benefits that ETFs seem to provide to the stock market in the Nordics would remain unchanged. The non-linearity of the correlation would suggest that at this moment, while the Nordic market is still relatively illiquid and young, ETFs do provide benefits to the stocks. However, as the market grows the impact might reverse.

The effect that ETFs have on the stock market in the US, a more established market may be the future for the Nordics too.

The results imply that the Nordic and the US market are at different stages regarding stock market development. As the Nordic market grows and further develops or integrates more with the global market, it is important to pay attention to the change that may happen in the effect of ETFs. Based in the information provided in this study, the Nordic market should welcome ETFs and furthermore informed investors. On the other hand, regulators should be aware of the effect that ETFs may have in the future as the market grows. Agarwal (2007) found that institutional ownership adds liquidity in the underlying shares up to a certain point. After the ownership exceeded 40% the effect turned around. The results of this study imply a similar effect as ETF ownership was found to demonstrate a non-linear correlation to volatility. Therefore, the same effect could happen in the Nordic regarding ETFs. As long as the Nordic market remains relatively illiquid, it benefits from more informed investors but at some point, added ETFs and trading volume may result in added noise and volatility.

5.1 Suggestions for further research

This study contributed to the existing literature in several ways. First, the impact of ETFs has been rarely studied in any other markets than in the US market. Further, no studies on the subject had been made using data from the Nordic market. Second, the results found in the Nordic market differ significantly from the ones found in the US. Not only were the results different but on many parts, they were the complete opposite. That is why the topic and the reasons behind the opposite results should be further researched.

The conclusion reached in this study was that due to the lack of liquidity and size in the Nordic market, introducing new informed investors adds a new layer of competition leading to a more efficient market. However, there were many fields that remained unresearched.

Fist, the inspection of fund-level differences between the Nordic and the US market were excluded from this study. To fully understand the differenced of the ETF market we need to examine the activities of ETFs on fund level. Even though ETFs investing in the Nordic market are international and rarely from the Nordic countries, there might be differences between funds investing in the US stock market and in the Nordic stock market.

Second, in this study I used monthly data. To further investigate the impact of fund flows, daily fund flows should be examined to reach more specific results. In addition, volatility was calculated as daily stock volatility. The impact of ETFs should also be calculated on intraday volatility. Even if ETFs would decrease daily volatility, it might have a different effect on intraday volatility.

Third, it would be interesting to investigate the same impact that ETFs have on other European markets, such as Germany or France, that are larger than the Nordic market in terms of size, and more liquid, but still smaller and less liquid than the US. The interesting aspect would be, in which point does the effect of ETFs change from liquidity provision (in the Nordics) to liquidity trading (in the US). By studying countries in different stages of stock market development and size, the future impact of ETFs in the Nordics could be predicted based on findings made in other markets.

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APPENDICES

Appendix A: Heteroscedastic and autocorrelation consistent coefficients

Table 13

Heteroskedasticity and autocorrelation consistent coefficients for ETF ownership and daily stock volatility

This table presents the heteroscedasticity and autocorrelation consistent coefficients for Table 4 presenting the relationship between *ETF ownership* and *daily stock volatility*. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels.

Dependent variable:	Volatility		
	(1)	(2)	(3)
ETF ownership	-0.071**		
	(0.022)		
ETF turnover		-0.0002*	
		(0.000)	
ETF ownership flow			-0.001.
			(0.001)
Index fund ownership	0.002	-0.007	-0.012
	(0.009)	(0.010)	(0.010)
Hedge fund ownership	-0.026	-0.024	-0.034.
	(0.020)	(0.020)	(0.019)
Log(Market Cap EUR)	-0.002	-0.002	-0.004*
	(0.002)	(0.002)	(0.002)
Volume	0.271***	0.247**	0.253**
	(0.076)	(0.077)	(0.088)
Bid-Ask Spread	0.038	0.029	0.088*
	(0.060)	(0.060)	(0.034)
1/Price	0.006	0.006	-0.001
	(0.005)	(0.005)	(0.006)
12 month return	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Amihud ratio	-0.000	-0.000	0.000.
	(0.000)	(0.000)	(0.000)
Book to Market	0.002	0.002	0.002.
	(0.001)	(0.001)	(0.001)
Gross profitability	-0.004	-0.003	-0.001
	(0.002)	(0.002)	(0.002)
Skewness	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)

Table 14

Heteroskedasticity and autocorrelation consistent coefficients for trading volume

This table presents the heteroscedasticity and autocorrelation consistent coefficients for Table 7 presenting the relationship between *ETF ownership* and *trading volume*. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels.

Dependent variable:	Trading volume		
	(1)	(2)	(3)
ETF ownership	0.093*		
	(0.042)		
ETF turnover		0.000	
		(0.000)	
ETF flow			0.000
			(0.001)
Index fund ownership	0.007	0.020	0.021.
	(0.011)	(0.012)	(0.012)
Hedge fund ownership	-0.014	-0.017	-0.017
	(0.027)	(0.027)	(0.025)
Log(Market Cap)	-0.005**	-0.005**	-0.004**
	(0.002)	(0.002)	(0.002)
Gross profitability	-0.003	-0.003	-0.003
	(0.003)	(0.002)	(0.002)
12-month return	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)
Book-to-Market ratio	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)
Amihud ratio	-0.000*	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)
Bid-ask-spread	-0.023	-0.015	0.008
	(0.041)	(0.041)	(0.029)
Month fixed effects	Yes	Yes	Yes
Company fixed effects	Yes	Yes	Yes

Table 15

Heteroskedasticity and autocorrelation consistent coefficients for bid-ask-spread

This table presents the heteroscedasticity and autocorrelation consistent coefficients for Table **8**8 presenting the relationship between *ETF ownership* and *bid-ask-spread*. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels.

Dependent variable:	Bid-ask-spread		
	(1)	(2)	(3)
ETF ownership	0.014.		
	(0.008)		
ETF turnover		-0.000**	
		(0.000)	
ETF flow			-0.000
			(0.000)
Index fund ownership	0.027	0.030.	0.029.
	(0.17)	(0.018)	(0.018)
Hedge fund ownership	0.055	0.054	0.060
	(0.057)	(0.057)	(0.057)
Log(Market cap)	-0.003***	-0.003**	-0.002**
	(0.001)	(0.001)	(0.001)
1/Price	0.005*	0.005*	0.006**
	(0.002)	(0.002)	(0.002)
12-month return	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Book-to-market ratio	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)
Free float %	0.000	0.000	-0.000
	(0.001)	(0.001)	(0.001)
Month fixed effects	Yes	Yes	Yes
Company fixed effects	Yes	Yes	Yes

Table 16

Heteroskedasticity and autocorrelation consistent coefficients for Amihud ratio

This table presents the heteroscedasticity and autocorrelation consistent coefficients for Table 9 presenting the relationship between *ETF ownership* and *Amihud ratio* (2002). Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels.

Dependent variable:	Amihud ratio		
	(1)	(2)	(3)
ETF ownership	-0.310***		
	(0.120)		
ETF turnover		-0.002.	
		(0.001)	
ETF flow			0.001
			(0.004)
Index fund ownership	0.042	0.009	0.023
	(0.055)	(0.057)	(0.055)
Hedge fund ownership	-0.027	-0.022	-0.004
	(0.156)	(0.149)	(0.152)
Log(Market Cap)	-0.093***	-0.093***	-0.089***
	(0.010)	(0.010)	(0.010)
Gross profitability	0.011	0.012	0.006
	(0.013)	(0.013)	(0.012)
12-month return	0.002	0.002	0.003
	(0.002)	(0.002)	(0.002)
Book-to-Market ratio	0.028***	0.029***	0.029***
	(0.004)	(0.004)	(0.004)
Trading volume	-2.736***	-2.860***	-3.262***
	(0.473)	(0.465)	(0.577)
Bid-ask-spread	0.611	0.571	0.482
	(0.526)	(0.520)	(0.499)
Month fixed effects	Yes	Yes	Yes
Company fixed effects	Yes	Yes	Yes

Table 17

Heteroskedasticity and autocorrelation consistent coefficients for return comovement

This table presents the heteroscedasticity and autocorrelation consistent coefficients for Table 10 presenting the relationship between *ETF ownership* and *beta*. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels.

Dependent variable:	Beta		
	(1)	(2)	(3)
ETF ownership	-0.105***		
	(0.021)		
ETF turnover		-0.010	
		(0.011)	
ETF ownership flow			-0.009
			(0.008)
Index fund ownership	0.050	0.016	0.011
	(0.042)	(0.043)	(0.044)
Hedge fund ownership	0.002	0.003	-0.002
	(0.025)	(0.025)	(0.025)
Log(Market Cap EUR)	-0.448**	-0.430**	-0.286*
	(0.141)	(0.148)	(0.136)
Volume	0.609	2.310	3.723
	(3.927)	(3.924)	(4.091)
Book to Market	-0.066	-0.070	-0.058
	(0.048)	(0.049)	(0.046)
Month fixed effects	Yes	Yes	Yes
Stock fixed effects	Yes	Yes	Yes

Table 18

Heteroskedasticity and autocorrelation consistent coefficients for excess returns

This table presents the heteroscedasticity and autocorrelation consistent coefficients for Table 12, Panel B presenting the relationship between *ETF ownership* and *the return of a high ETF ownership minus low ETF ownership portfolio*. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels.

Dependent variable:	Return(High-Minus-Low ETF Ownership)
Alpha	-0.208**
	(0.067)
MKTRF	0.005
	(0.052)
SMB	-0.289**
	(0.088)
HML	-0.251*
	(0.126)
RMW	-0.072
	(0.162)
CMA	0.185
	(0.135)
Momentum	0.000
	(0.001)

Appendix B: Robustness subsets

Table 19

Subsamples - Annual samples

This table presents the stock/month panel regression measuring the effect of ETF ownership of a stock included in the OMX Nordic 120 on its volatility divided into subsamples based on annual samples. Share volatility is calculated as the average daily volatility of each share in the previous month. *ETF ownership* is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. *ETF turnover* is the weighted turnover of ETF's holding of the share. ETF ownership flow is the change in ETF ownership in the share each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's market capitalization on the last day of each month. *Volume* is the average daily trading volume of each share during the previous month. *Gross profitability* is calculated as Novy-Marx (2013). *1/Price* is the inverse share price during the last day of the month. *12-month return* is the return of the stock during the previous year. *Book to Market* is the book to market ratio of each company on the last day of each month. *Amihud ratio* is calculated as Amihud (2002). *Bid-ask-spread* is calculated as the average bid-ask-spread of a stock during the previous month. *Skewness* is the average daily skewness of each share during the previous month. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels. R-squared excludes the explanatory power of fixed effects.

Dependent variable	Volatility									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ETF ownership	0.060	-0.004	-0.126*	-0.133**	0.014	0.011	-0.062**	-0.179*	0.041	0.157***
	(0.112)	(0.054)	(0.049)	(0.049)	(0.034)	(0.036)	(0.023)	(0.070)	(0.039)	(0.036)
Index fund ownership	0.007	-0.012	0.021	-0.004	0.009	0.026	0.007	0.017	0.008	0.031
	(0.026)	(0.029)	(0.027)	(0.026)	(0.026)	(0.023)	(0.023)	(0.022)	(0.017)	(0.029)
Hedge fund ownership	0.056	-0.337***	0.014	-0.011	0.020	-0.036	0.038	-0.036	-0.071	0.076
	(0.041)	(0.049)	(0.047)	(0.195)	(0.045)	(0.111)	(0.094)	(0.072)	(0.058)	(0.057)
Log(Market Cap EUR)	-0.008*	-0.003	-0.021***	0.007	-0.004	-0.006	-0.002	0.004	0.009***	0.000
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.003)	(0.005)
Volume	0.346***	0.269***	0.559***	0.570***	0.238***	0.518***	0.609***	1.371***	2.998***	2.243***
	(0.042)	(0.042)	(0.065)	(0.078)	(0.048)	(0.065)	(0.083)	(0.121)	(0.143)	(0.144)
Bid-Ask Spread	-0.092	0.060	0.056	-0.053	0.088	0.310.	1.192***	0.549	1.510***	1.365.
	(0.063)	(0.042)	(0.059)	(0.072)	(0.068)	(0.184)	(0.357)	(0.738)	(0.702)	(0.758)

Annual samples – constinued

1/Price	0.008**	0.040*	0.021.	0.067***	-0.030.	-0.079*	0.011	0.074*	0.084*	0.035
	(0.003)	(0.017)	(0.011)	(0.013)	(0.016)	(0.032)	(0.050)	(0.036)	(0.036)	(0.044)
12 month return	-0.003***	0.000*	-0.001	-0.002.	0.001	0.000	0.001	-0.004***	0.001	-0.002
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Amihud ratio	0.000	0.001*	0.001*	-0.000	0.001	0.001.	0.001	0.002*	0.002*	0.010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)
Book to Market	-0.001	-0.001	0.002	-0.001	-0.002	-0.006*	0.005**	0.001	0.003*	0.003
	(0.001)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.001)	(0.001)	(0.002)
Gross profitability	-0.000	0.001	0.014	-0.001	-0.001	-0.003	0.013	0.002	-0.002	-0.004
	(0.012)	(0.009)	(0.012)	(0.005)	(0.009)	(0.008)	(0.011)	(0.013)	(0.007)	(0.007)
Skewness	0.001***	0.001***	-0.000	0.000	0.001***	0.001***	0.001***	-0.000**	-0.000***	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,080	1,090	1,104	1,104	1,104	1,127	1,142	1,159	1,171	1,196
R-squared	0.1321	0.1328	0.1755	0.0849	0.0661	0.0915	0.0928	0.1651	0.3239	0.2274

Table 20

Subsamples - Industry samples

This table presents the stock/month panel regression measuring the effect of ETF ownership of a stock included in the OMX Nordic 120 on its volatility divided into subsamples based on industry classifications retrieved from Thomson Reuters Eikon. *Share volatility* is calculated as the average daily volatility of each share in the previous month. *ETF ownership* is the percentage of the stock held by ETF's, using data from Eikon Thomson Reuters -database, on the last day of each month. *ETF turnover* is the weighted turnover of ETF's holding of the share. *ETF ownership flow* is the change in ETF ownership in the share each month. *Index fund ownership* is the percentage of stock held by index funds on the last day of each month. ETF ownership is included in index fund ownership. *Hedge fund ownership* is the percentage of the stock held by hedge funds on the last day of each month. *Log(Market Cap)* is the firm's market capitalization on the last day of each month. *Volume* is the average daily trading volume of each share during the previous month. *Gross profitability* is calculated as Novy-Marx (2013). *1/Price* is the inverse share price during the last day of the month. *12-month return* is the return of the stock during the previous year. *Book to Market* is the book to market ratio of each company on the last day of each month. *Amihud ratio* is calculated as Amihud (2002). *Bid-ask-spread* is calculated as the average bid-ask-spread of a stock during the previous month. *Skewness* is the average daily skewness of each share during the previous month. Standard deviation is presented in the parenthesis. ***, **, * and . signify statistical significance at 0.1%, 1%, 5% and 10% levels. R-squared excludes the explanatory power of fixed effects.

Dependent variable	Volatility									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ETF ownership	-0.081***	-0.042	-0.162	-0.151***	-0.048**	0.044	-0.027	0.049	0.024	-0.266
	(0.013)	(0.051)	(0.127)	(0.028)	(0.015)	(0.033)	(0.030)	(0.306)	(0.052)	(0.306)
Index fund ownership	0.022***	0.002	0.039	-0.000	0.023.	-0.106.	-0.021	-0.123	-0.154	-0.074
	(0.005)	(0.018)	(0.062)	(0.014)	(0.012)	(0.060)	(0.015)	(0.308)	(0.207)	(0.059)
Hedge fund ownership	-0.041***	0.092.	-0.408*	0.443**	-0.078**	0.017	0.131	-0.128	-0.068	0.906.
	(0.013)	(0.055)	(0.194)	(0.148)	(0.012)	(0.019)	(0.085)	(0.698)	(0.081)	(0.523)
Log(Market Cap EUR)	0.000	0.005	0.002	-0.008*	-0.012***	-0.004	0.005**	-0.059	-0.004	-0.018
	(0.001)	(0.005)	(0.003)	(0.004)	(0.002)	(0.004)	(0.002)	(0.053)	(0.007)	(0.026)
Volume	0.373***	0.806***	0.732***	0.495***	0.064*	0.049	0.225**	0.927	1.181***	2.420***
	(0.021)	(0.128)	(0.141)	(0.087)	(0.027)	(0.092)	(0.079)	(0.809)	(0.211)	(0.459)
Bid-Ask Spread	0.045*	-0.312	0.402	0.345**	0.268*	0.542.	0.135.	-6.099	-1.711	2.005
	(0.021)	(0.330)	(0.369)	(0.116)	(0.131)	(0.323)	(0.071)	(7.844)	(1.034)	(1.675)
1/Price	0.006***	-0.222	0.103	-0.144***	0.055***	-0.374	-0.134***	-0.797.	-0.198***	-0.241*
	(0.002)	(0.169)	(0.123)	(0.039)	(0.013)	(0.293)	(0.039)	(0.457)	(0.211)	(0.099)
12 month return	-0.001**	-0.003*	0.002	-0.001	0.001.	0.001	-0.003**	0.008	-0.001	0.005
	(0.000)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.011)	(0.003)	(0.005)
Amihud ratio	0.000	0.061***	0.007	0.000*	0.001***	0.091*	0.027***	0.025*	0.017.	0.010*
	(0.000)	(0.012)	(0.005)	(0.000)	(0.000)	(0.038)	(0.007)	(0.011)	(0.010)	(0.005)

	Industry samples - continued									
Book to Market	0.001***	0.006*	0.010.	-0.001**	0.006***	0.006	0.007**	0.065*	0.044*	0.005
	(0.000)	(0.003)	(0.005)	(0.000)	(0.001)	(0.005)	(0.002)	(0.030)	(0.021)	(0.009)
Gross profitability	-0.008***	-0.016*	-0.020*	-0.022	0.139***	0.004*	0.001	-0.138	-0.026	-0.023
	(0.001)	(0.007)	(0.008)	(0.041)	(0.023)	(0.002)	(0.003)	(0.123)	(0.030)	(0.020)
Skewness	0.000**	0.000	0.000	0.001.	-0.000*	0.001*	-0.001***	0.000	0.002.	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	6,328	538	480	360	1,560	360	720	151	240	180
R-squared	0.0965	0.2010	0.2532	0.4105	0.2665	0.2775	0.0999	0.5559	0.3596	0.5903
Adjusted R-squared	0.0688	-0.0673	-0.0368	0.0636	0.1924	-0.1477	-0.1101	-2.7007	-0.4305	-0.5605

Table 21 Industry classifications

No.	Industry
(1)	Manufacturing
(2)	Administrative and Support and Waste Management and Remediation Services
(3)	Retail Trade
(4)	Real Estate and Rental and Leasing
(5)	Finance and Insurance
(6)	Transportation and Warehousing
(7)	Information
(8)	Utilities
(9)	Professional, Scientific, and Technical Services
(10)	Mining, Quarrying, and Oil and Gas Extraction

Appendix C: Commands used in R

Correlations in Table 3

```
> cor(OG, use="complete.obs")
```

ETF ownership and share volatility in Table 4

Fixed effects using plm

```
> x2<-plm(volatility ~ etf + index + hedge + mc + volume + bidask + pr
ice + ret + amihud + bm + prof, data=OG, index=c("comp", "date"), ,mod
el="within", effect="twoways")
```

Coefficient test

```
> coeftest(x2, vcov. = vcovHC, type="HC1")
```

ETF ownership and share liquidity in Table 7, Table 8 and Table 9

Fixed effects using plm

```
> fixed<- plm(bidask ~ etf + index + hedge + mc + price + ret + bm + R
_template$Freef, data=OG, index = c("comp", "date"), model="within")
```

Coefficient test

```
> coeftest(fixed, vcov. = vcovHC, type="HC1")
```

ETF ownership and share comovement in Table 10

Fixed effects using plm

```
> como<- plm(beta ~ etf + index + hedge + mc + volume + bm, data=OG, i
ndex = c("comp", "date"), model="within")
```

Coefficient test

```
> coeftest(como, vcov. = vcovHC, type="HC1")
```

ETF ownership and excess returns in Table 12

Panel A

```
> reg20<-rq(ETF ~ exret, data=quantile, tau=c(0.05, 0.25, 0.5, 0.75,
0.95))
```

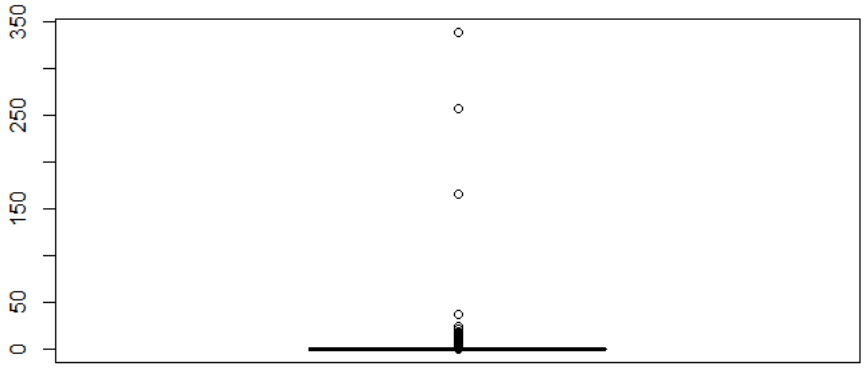
Panel B

```
> highlow<-lm(ret ~ alpha + mktrf + smb + hml + rmw + cma + mom,
data=high)
```

ETF ownership and Amihud ratio – removal of outliers in Table 9

Illustration of Amihud ratios with outliers.

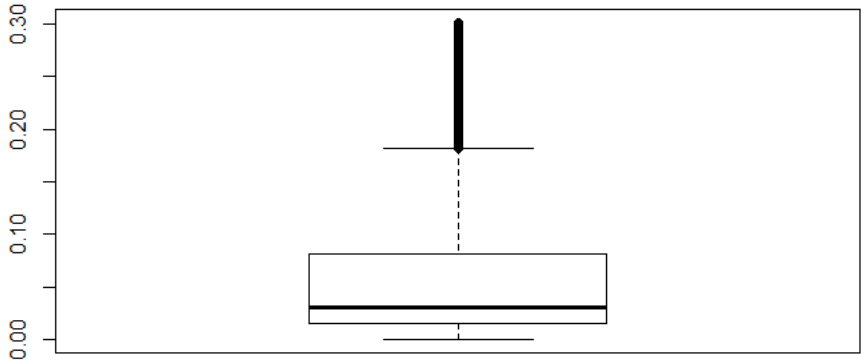
```
> boxplot(OG$amihud)
```



Removal of outliers

```
> boxplot(OG$amihud)$out
> outliers<-(boxplot(OG$amihud)$out)
> OG[which(OG$amihud %in% outliers),]
> boxplot(out$amihud)
```

Illustration of Amihud ratios after removal of outliers.



Appendix D: Companies included in the sample

No.	Ticker	Company name	Country of headquarters	Comment
1	AAK.ST	AAK AB (publ)	Sweden	
2	ABB	Abb Ltd	Switzerland	
3	ALFA.ST	Alfa Laval AB	Sweden	
4	ALV	Autoliv Inc	Sweden	
5	AMBUb.CO	Ambu A/S	Denmark	
6	AMEAS.HE	Amer Sports Oyj	Finland	
7	ASSAb.ST	Assa Abloy AB	Sweden	
8	ATCOa.ST	Atlas Copco AB	Sweden	
9	ATCOb.ST	Atlas Copco AB	Sweden	
10	AXFO.ST	Axfood AB	Sweden	
11	AZN.L	AstraZeneca PLC	United Kingdom	
12	BALDb.ST	Fastighets AB Balder	Sweden	
13	BILL.ST	BillerudKorsnas AB (publ)	Sweden	
14	BOL.ST	Boliden AB	Sweden	
15	CARLb.CO	Carlsberg A/S	Denmark	
16	CAST.ST	Castellum AB	Sweden	
17	CGCBV.HE	Cargotec Oyj	Finland	
18	CHRH.CO	Chr Hansen Holding A/S	Denmark	Listed during sample period
19	COLOb.CO	Coloplast A/S	Denmark	
20	DANSKE.CO	Danske Bank A/S	Denmark	
21	DOMETIC.ST	Dometic Group AB (publ)	Sweden	Listed during sample period
22	DSV.CO	DSV A/S	Denmark	
23	EKTAb.ST	Elekta AB (publ)	Sweden	
24	ELISA.HE	Elisa Oyj	Finland	
25	ELUXb.ST	Electrolux AB	Sweden	
26	EPIRa.ST	Epiroc AB	Sweden	Listed during sample period
27	EPIRb.ST	Epiroc AB	Sweden	Listed during sample period
28	ERIBR.HE	Telefonaktiebolaget LM Ericsson	Sweden	Excluded from the sample
29	ESSITYb.ST	Essity AB (publ)	Sweden	Listed during sample period
30	FABG.ST	Fabege AB	Sweden	
31	FLS.CO	Flsmidth & Co A/S	Denmark	
32	FORTUM.HE	Fortum Oyj	Finland	
33	GEN.CO	Genmab A/S	Denmark	
34	GETIb.ST	Getinge AB	Sweden	
35	GN.CO	GN Store Nord A/S	Denmark	
36	HEXAb.ST	Hexagon AB	Sweden	
37	HMb.ST	H & M Hennes & Mauritz AB	Sweden	
38	HPOLb.ST	Hexpol AB	Sweden	
39	HUH1V.HE	Huhtamaki Oyj	Finland	
40	HUSQb.ST	Husqvarna AB	Sweden	
41	ICAA.ST	ICA Gruppen AB	Sweden	
42	INDUc.ST	Industrivarden AB	Sweden	
43	INTRUM.ST	Intrum AB	Sweden	
44	INVEa.ST	Investor AB	Sweden	
45	INVEb.ST	Investor AB	Sweden	
46	ISS.CO	Iss A/S	Denmark	Listed during sample period
47	JYSK.CO	Jyske Bank A/S	Denmark	
48	KCRA.HE	Konecranes Abp	Finland	
49	KESKOB.HE	Kesko Oyj	Finland	
50	KINDsdb.ST	Kindred Group PLC	Malta	
51	KINVb.ST	Kinnevik AB	Sweden	
52	KNEBV.HE	Kone Oyj	Finland	
53	LOOMb.ST	Loomis AB	Sweden	
54	LUN.CO	H Lundbeck A/S	Denmark	

55	LUPE.ST	Lundin Petroleum AB	Sweden	
56	MAERSKa.CO	AP Moeller - Maersk A/S	Denmark	
57	MAERSKb.CO	AP Moeller - Maersk A/S	Denmark	
58	METSB.HE	Metsa Board Oyj	Finland	
59	METSO.HE	Metso Oyj	Finland	
60	MTGb.ST	Modern Times Group MTG AB	Sweden	
61	NDAFI.HE	Nordea Bank Abp	Finland	
62	NESTE.HE	Neste Oyj	Finland	
63	NIBEb.ST	Nibe Industrier AB	Sweden	
64	NOKIA.HE	Nokia Oyj	Finland	
65	NOVOb.CO	Novo Nordisk A/S	Denmark	
66	NRE1V.HE	Nokian Tyres plc	Finland	
67	NZYMb.CO	Novozymes A/S	Denmark	
68	ORNBV.HE	Orion Oyj	Finland	
69	ORSTED.CO	Orsted A/S	Denmark	Listed during sample period
70	PNDORA.CO	Pandora A/S	Denmark	Listed during sample period
71	RBREW.CO	Royal Unibrew A/S	Denmark	
72	ROCKb.CO	Rockwool International A/S	Denmark	
73	SAABb.ST	Saab AB	Sweden	
74	SAMPO.HE	Sampo Oyj	Finland	
75	SAND.ST	Sandvik AB	Sweden	
76	SCAb.ST	Svenska Cellulosa SCA AB	Sweden	
77	SEBa.ST	Skandinaviska Enskilda Banken AB	Sweden	
78	SECUb.ST	Securitas AB	Sweden	
79	SHBa.ST	Svenska Handelsbanken AB	Sweden	
80	SIM.CO	Simcorp A/S	Denmark	
81	SKAb.ST	Skanska AB	Sweden	
82	SKFb.ST	AB SKF	Sweden	
83	SOBIV.ST	Swedish Orphan Biovitrum AB (publ)	Sweden	
84	SSABb.ST	SSAB AB	Sweden	
85	STERV.HE	Stora Enso Oyj	Finland	
86	SWEDa.ST	Swedbank AB	Sweden	
87	SWMA.ST	Swedish Match AB	Sweden	
88	SYDB.CO	Sydbank A/S	Denmark	
89	TEL2b.ST	Tele2 AB	Sweden	
90	TELIA.ST	Telia Company AB	Sweden	
91	THULE.ST	Thule Group AB	Sweden	Listed during sample period
92	TIGOsdb.ST	Millicom International Cellular SA	Luxembourg	
93	TOP.CO	Topdanmark A/S	Denmark	
94	TRELb.ST	Trelleborg AB	Sweden	
95	TRYG.CO	Tryg A/S	Denmark	
96	UPM.HE	UPM-Kymmene Oyj	Finland	
97	VALMT.HE	Valmet Oyj	Finland	Listed during sample period
98	VNE	Veoneer Inc	Sweden	Listed during sample period
99	VOLVb.ST	Volvo AB	Sweden	
100	VWS.CO	Vestas Wind Systems A/S	Denmark	
101	WDH.CO	Demant A/S	Denmark	
102	WRT1V.HE	Wartsila Oyj Abp	Finland	