NOW YOU SEE ME, NOW YOU DON'T: THE IMPACT OF POST TRADE ANONYMITY ON LIQUIDITY IN THE HELSINKI STOCK EXCHANGE

Jyväskylä University
School of Business and Economics

Master's Thesis

2023

Author: Vertti Launiainen
Subject: Banking and International Finance
Supervisor: Heikki Lehkonen

JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

ABSTRACT

Author
Vertti Launiainen

Title
Now you see me, now you don't: The impact of post trade anonymity on liquidity in the Helsinki Stock Exchange

Subject	Type of work
Banking and International Finance	Master´s Thesis
Date	Number of pages
24.11.2023	50

The evolution of transparency in financial markets has raised questions regarding its relation to liquidity. The shift towards less transparency in trading has been apparent with first, the increase of pre-trade anonymity followed by post-trade anonymity. Despite this, there are still differences between stock exchanges and uncertainty exists as to which measure to adopt. This thesis examines the effects of post-trade anonymity on liquidity for small and medium market capitalization companies. Liquidity is measured through the bid-ask spread, turnover value, turnover volume, and turnover ratio. The thesis focuses on the Helsinki Stock Exchange which experienced an increase in post-trade anonymity in late 2022 when broker identifications were hidden post-trade for small and medium sized companies alongside large companies which experienced this change in 2020. This formed a quasi-experimental setup which was investigated using the difference-in-differences model in which the small and medium sized stocks formed the treatment group and the large stocks the control group. The empirical results indicate that the increase in post-trade anonymity had a significant positive impact on liquidity in all of the four measures. Furthermore, the observed increases in liquidity were more severe within the small market capitalization stocks. Worth noting is that while liquidity improved for both the control and treatment group in some measures such as the bid-ask spread, the effect was much greater for the treatment group which had experienced the increase in post-trade anonymity. This suggests that the expansion of post-trade anonymity to small and medium sized stocks was beneficial for liquidity and therefore the overall health of the Helsinki Stock Exchange.

Key words
Liquidity, Post-trade anonymity, Market transparency, Broker identification

Place of storage
Jyväskylä University Library

TIIVISTELMÄ

Tekijä
Vertti Launiainen

Työn nimi
Now you see me, now you don't: The impact of post trade anonymity on liquidity in the Helsinki Stock Exchange

Oppiaine	Työn laji
Banking and International Finance	Pro gradu -tutkielma
Päivämäärä 24.11.2023	Sivumäärä 50

Läpinäkyvyyden kehittyminen rahoitusmarkkinoilla on herättänyt kysymyksiä sen vaikutuksista likviditeettiin. Siirtymä kohti vähempää läpinäkyvyyttä kaupankäynnissä on noussut pinnalle, ennen kauppaa tapahtuvan anonymiteetin lisääntymisessä ja hiljattain kaupankäynnin jälkeisen anonymiteetin lisääntymisessä. Tästä huolimatta eroja eri pörssien välillä on havaittavissa, ja epävarmuus vallitsee sen suhteen, mitä käytäntöä tulisi noudattaa. Tämä tutkielma tutkii kaupankäynnin jälkeen tapahtuvan anonymiteetin vaikutuksia likviditeettiin pienissä ja keskisuurissa markkina-arvon yrityksissä. Likvideettiä mitataan osto- ja myyntikurssin välisellä erolla, osakkeelle kohdituvan kaupankäynnin volyymilla, arvolla sekä vaihtuvuudella. Tutkielma keskittyy Helsingin pörssiin jossa, kaupankäynnin jälkeen tapahtuvaa anonymiteettiä lisättiin loppuvuodesta 2022, kun välittäjien tunnistetiedot piilotettiin kaupan toteutumisen jälkeen pienten ja keskisuurten yrityksien osalta. Suuret yritykset, olivat kokeneet tämän muutoksen jo vuonna 2020. Tästä muodostuva puolisatunnaistettu asetelmaa tutkittiin käyttäen Difference-in-Differences menetelmää, jossa pienet ja keskisuuret osakkeet muodostivat käsittelyryhmän ja suuret osakkeet vertailuryhmän. Tutkielman empiiriset tulokset osoittavat, että kaupankäynnin jälkeen tapahtuvan anonymiteetin lisääntyminen vaikutti positiivisesti likviditeettiin tutkielman parametreillä mitattuna. Lisäksi havaittu likviditeetin lisääntyminen oli suurempaa pienten markkina-arvon osakkeilla. Tietyillä mittareilla likvideetti parani sekä vertailu- että käsittelyryhmässä mutta, vaikutus oli huomattavasti suurempi käsittelyryhmässä johon muutos kohdistui. Tämä viittaa siihen, että kaupankäynnin jälkeisen anonymiteetin laajentaminen pienten ja keskisuurten yrityksien pariin edesauttoi likvideettiä ja täten Helsingin pörssin yleistä terveyttä.

Asiasanat
Likvideetti, Kaupankäynnin jälkeinen anonymiteetti, Välittäjätiedot

Säilytyspaikka
Jyväskylän Yliopiston kirjasto

CONTENTS

LIST OF TABLES AND FIGURES

1 INTRODUCTION

1.1 Background

The inspiration for this master thesis came when Nasdaq Nordic announced on the 11th of October 2022 that it would remove broker data from the order books of the Nordic exchanges due to request from international brokers and claims of improved market conditions (Lehtinen, 2022). This change was applied to small and medium-sized companies since large firms had already fully adopted this change in 2020. The process of eliminating broker data from the exchanges of Nasdaq Nordic has been a gradual one. Broker bid identifiers (IDs) were eliminated in the early 2000s, and subsequent discussions have centered around the removal of broker trade IDs. In 2008 there was an attempt to increase post-trade anonymity in the Nasdaq Nordic exchanges but it was quickly reversed in 2009. These actions were studied by Dennis and Sandås (2020) and their results are highly valuable to this master thesis since once again Nasdaq Nordic is adopting similar post-trade anonymity measure increases.

Nasdaq's Nordic exchanges have been unique in that they have made broker information visible for participants in post-trade. In contrast, broker information has been hidden for years in the Oslo Stock Exchange operated by Euronext and other European exchanges. There is existing literature such as Frino, Johnstone, and Zheng (2010) that suggest knowing the counterparty's brokerage firm can be used by investors to assess market conditions and make investment decisions. Another use for broker information is to see if institutional investors or private investors are making purchases or sales of the equity which can be used to make trading decisions. Henrik Husman the CEO of Helsinki Stock Exchange explained in an interview[1] (Lehtinen, 2022) that the transparent nature of the exchanges has caused friction with some participants that are unfamiliar with operating in such open environments and that they have experienced disruption from parties making inferences from their transactions. In turn this has led to increased usage of secondary brokers in order to conceal identities, which ultimately can lead to high market shares for a few selected brokers, raising concerns. Furthermore, Husman (Lehtinen, 2022) explains that existing research suggests that anonymity increases market efficiency through narrower spreads and increased volume. For example, research conducted by Comerton-Forde and Tang (2009) revealed that the ability to remain anonymous while trading provides greater liquidity, allowing traders to keep their activities and intentions hidden while trading without being monitored. Furthermore, they discovered that, when controlling for other factors, anonymity leads to smaller spreads and greater order book depth. This is consistent with the research of Dennis and Såndas (2020) in the Nordic exchanges. They demonstrated that post-trade anonymity decreases quoted spreads compared to the control group in a way that is both

[1] Lehtinen, J. (2022). Kauppalehti. https://www.kauppalehti.fi/uutiset/valittajatietojen-poistaminen-osakekaupoista-harmittaa-sijoittajia-helsingin-porssin-henrik-husman-kertoo-miksi-paatos-tehtiin/8f45325e-19c2-49c0-8510-7af585a77ee3?ref=twitter%3A55bc

economically and statistically meaningful for firms of varying sizes. Additionally, price impact, which gauges the asymmetric information content of trades, was also lower when anonymous trade reporting was adopted in 2008. They also observed that switching to anonymity increased book depth compared to daily volume for firms of all sizes. Worth noting is that when Dennis and Såndas (2020) started to examine liquidity effects during the post-trade anonymity reversal in 2009, the results started to vary. For example, they discovered that when switching back to transparency only the large stocks displayed widened spreads with small and medium sized stock having statistically insignificant changes in spread. Another key point that could affect results is the timing of these changes. The Nasdaq Nordic deployed the switch to anonymity and reversal to transparency in 2008 and 2009 during which there was significant turmoil in the financial markets due to the global financial crisis.

The comments made by the CEO of the Helsinki Stock Exchange and curiosity to empirically test whether liquidity is impacted by the anonymity changes is the primary motivation for this master thesis. Additionally, the announcement caused a lot of public discourse amongst private investors. A Swedish trader Erik Lundin (Swee, 2022) argued in an interview that in the smaller companies, it is private individuals who are driving the market by actively trading. In larger companies, anonymity is not an issue to private investors but in small and medium sized companies, transparency is highly important to them. These types of traders actively view the buy and sell data regarding brokers and use it when making trading decisions. Now this useful tool is being taken from their trading toolbox, which seems to have caused some frustration and doubt as to liquidity improving specifically for small and medium sized companies despite evidence from the Nordic markets by Dennis and Såndas (2020). According to Åkerblom (2022) the real motive behind the alteration is the result of prolonged lobbying and large sums of money. This notion is in reference to discussion that spurred in 2013 werearound specialised anonymity treatment in Nasdaq Nordics. Cave (2013) reported that Nasdaq is considering implementing anonymity in its Nordic exchange for high-speed trading firms in order to reduce the potential for market manipulation by hiding the orders from other firms. These anonymity changes therefore were not totally surprising since signs had already existed.

Summa summarum, this thesis aims to explore the impact of post-trade anonymity on liquidity in the Helsinki Stock Exchange, and to draw conclusions from the empirical evidence collected. This research will add to the existing literature on the impacts of anonymity on liquidity and market efficiency, as well as provide information for regulators and policymakers. The research will also provide a basis for further research in this field.

1.2 Research objectives

This master's thesis researches and discusses stock market anonymity and liquidity in the markets. More specifically, the main objective of this research is to investigate the impact of post-trade anonymity on liquidity in the Helsinki Stock Exchange (HSE) since the implementation of a new anonymity measure by Nasdaq Nordic aiming to increase post-trade anonymity. Recently, there has been extensive public discourse concerning the subject of post-trade anonymity due to the anonymity changes that sparked the interest of this master thesis. Since this measure was introduced just recently in December of 2022 this thesis will be the first of its kind to investigate it. In order to address the lack of knowledge in this area, the main research question is:

What is the impact of increased post-trade anonymity on liquidity in the Helsinki stock exchange?

The main research question has been broken down into two sub-questions for further exploration:

1. *Which liquidity measures are most affected by increased post trade anonymity?*

2. *Do the effects vary between small and medium market capitalization stocks?*

This master's thesis will first start investigating the impacts on liquidity when post-trade anonymity was increased in the HSE. This research question is important because liquidity is fundamental to any financial market and has significant implications for the functioning and stability of the market. The analysis will begin with an overview of the current situation of liquidity in the market. This will include a discussion of the current trading volume, order flow, and spread of the HSE. This will provide a baseline for the analysis of the policy change. Second, the possible effects on liquidity are expanded on. Different liquidity measures are examined to determine to determine which liquidity measures are most impacted by increased post trade anonymity in order to understand how the market will be affected. Finally, firm characteristics are examined through their market capitalizations. Moreover, if the post-trade anonymity increase has different effects on liquidity based on firm's market capitalization.

1.3 Research design

The research design of this master thesis is focused on analysing the impact of increased post-trade anonymity on liquidity in the Helsinki stock exchange. The

most suitable method for achieving robust results in this case was identified to be the difference in differences method (DiD). This method has been utilized in previous research conducted by Dennis and Sandås (2020), and Friederich and Payne (2014). The data for the study was collected through Refinitiv Eikon, a financial data and analytics platform providing access to real-time and historical data across global markets. The main objective of the research is to measure the changes in liquidity of the Helsinki stock exchange after the introduction of expanded post-trade anonymity which made broker identifiers not visible post-trade for all companies.

The research design of this master thesis will go as follows. Firstly, the existing literature related to liquidity, post-trade anonymity, and the Helsinki stock exchange will be covered to provide an overview of the current state of research and highlight the gaps that this master thesis will aim to fill. Second, empirical analysis is conducted which will involve the gathering of data for Helsinki stock exchange before and after the introduction of post-trade anonymity. This data will be gathered through Refinitiv Eikon, which is a financial data provider. The data will consist of daily stock market data which will be specified and elaborated further, later in this research. This data will then be analysed using the Difference-in-Differences (DiD) method, which will compare the changes in liquidity of the Helsinki stock exchange before and after the introduction of post-trade anonymity. The control group in this study consists of large market capitalization stocks that already have post-trade anonymity measures applied to them in 2020. In contrast, the focus of the study is on medium and small market capitalization companies which were affected by the expansion of post-trade anonymity measures in 2022. The Difference-in-Differences method will be used to compare the changes in liquidity in the control group and the changes in liquidity in the focus group to measure the impact of the expansion of post-trade anonymity on liquidity. The results of this research will provide valuable insights into the effects of increased post-trade anonymity on liquidity in the Helsinki stock exchange, and will be useful for investors, traders, and policy makers alike.

1.4 Research structure

The following overview outlines the structure of this master thesis. The paper is organized into five chapters. The first chapter began by providing an overview of the topic and its relevance to the field of study. The second chapter discusses the academic literature around the topic and serve as a theoretical foundation for the thesis. The third chapter discusses the data sources and methods used to collect and analyse the data. The fourth chapter presents the results and discussion about the topic. The fifth and final chapter summarizes the findings and offers recommendations for future research.

2 THEORETICAL FRAMEWORK

This chapter will provide an overview of the theoretical framework behind the research topic of post-trade anonymity and liquidity. First, the concept of anonymity in the stock market is discussed. Second, liquidity and how it appears in the stock market is covered. Alongside this, common ways of measuring liquidity will also be provided and reviewed. Following this, current research and literature around how post-trade anonymity impacts liquidity will be reviewed. Similar research around the research topic is presented making the chapter significant. Finally, an overview of the Helsinki Stock Exchange is presented since that is our main market of interest in this master thesis.

2.1 Anonymity

Anonymity is a complex and widely researched subject across many different fields. For instance, in psychology anonymity is described by Christopherson (2007) as "the inability of others to identify an individual or for others to identify one's self." The presence of anonymity can both have positive and negative consequences. When it comes to equity markets this topic is also of high debate. The degree to which anonymity is applied has been an interest of policymakers and regulators for decades. Throughout the history of equity markets there has not been a universal approach to the level of transparency a specific market has. Market transparency is described as a fundamental question regarding the structure and regulation of stock markets by Bloomfield and O'Hara (1999). When purchasing or selling stocks anonymity refers to the practice of concealing one's identity when conducting these trades, making it difficult to trace the identity of the buyer or seller according to Comerton-Forde and Tang (2009). In practice this means that counterparties of a trade are visible through broker identifiers (ID). According to Comerton-Forde and Tang (2011) traders gain an understanding of order flow and price discovery in the market from having the broker ID data visible. By determining the identity of the brokers behind an order, traders can gain insights into the motivations and strategies behind trading decisions. The visibility of trading data can be split into pre- and post-trade. There have been variations as to the extent of transparency treatment in terms of pre- and post-trade but currently no major stock exchange provides visibility to pre-trade broker ID information. Broker IDs became hidden in the pre-trade phase after the US Securities and Exchange Commission (SEC) passed Regulation NMS in 2005. The regulation allowed broker identification information to remain confidential until after the trade had been completed (SEC, 2005). As a result of pre-trade anonymity being increasingly a standard in markets (Meling, 2021), there has been a significant shift in the conversation amongst policy makers and academics over

the past decade towards post-trade anonymity. Nowadays even though the broker ID in post-trade has been hidden in the HSE the number of shares and purchase price is still visible. However, this information was more valuable in theory to informed investors when the broker ID was available alongside the quantity and price data.

2.2 Liquidity

Liquidity is amongst the top interests of researchers when examining how stock exchanges operate and evaluating their quality level. It is also an important subject when evaluating policy and regulation changes. Finding a universal and all-encompassing definition for liquidity is difficult. O'Hara (2004, p.1) adequately describes this problem surrounding liquidity as "it is hard to define, but you know it when you see it". One example of this type of definition is the one obtained from Keynes (1930) which says liquidity is the capability of a security to be transformed into cash without major loss of value. A similar description is found in, for instance Fang et al. (2009), which explains that stock market liquidity is defined as the ability of investors to quickly buy and sell stocks with minimal impact on the price. This liquidity depends on the supply-demand relationship for a certain stock and is determined by several factors, such as the number of buyers, sellers, and market makers. Liquidity implies that the transaction costs for buying and selling a stock are low, allowing investors to enter or exit the market with minimal cost. In addition, it also reflects the speed of execution of a trade. Moreover, liquidity is a key factor in the pricing of securities. According to Amihud and Mendelson (1986) investors should demand higher returns from less liquid securities in order to offset the higher trading costs. However, even the most liquid markets place a premium on investors if they desire immediate selling or buying of an asset. This premium is the difference between the bid and ask prices which is an indication of how liquid an asset is, as it is the combined result of the premium required for an immediate purchase and the concession needed for immediate sale (Kumar and Misra, 2015, p.36). Naturally this premium is smaller for more liquid assets and vice versa. Liquidity is therefore essential for efficient functioning of the market and affects the ability of investors to carry out their trading activities. However, liquidity can be interpreted differently in calm and turbulent times according to Baker (1996). In calm conditions liquidity is reflected through transaction costs but in turbulent conditions importance shifts towards finding the optimal price level and reaching price symmetry.

According to Sarr and Lybek (2002) there are five distinct attributes that liquid markets display:

I. Tightness: Low transaction costs such as the bid-ask spread
II. Immediacy: The speed of order execution
III. Depth: The presence of ample orders
IV. Breadth: There are large quantities and volumes of orders
V. Resiliency: If price levels dramatically alter from fundamentals there is rapid order flow to adjust the imbalance

These attributes are naturally affected by certain factors. Fang et al. (2009) says that factors influencing the liquidity of a stock include market capitalization, daily trading volume, institutional ownership, and analyst coverage. Additionally, the investor sentiment towards a stock, the trading costs, and the regulatory environment can also affect the liquidity of a stock.

2.3 Measuring liquidity

Liquidity can be measured in many different ways. In order to achieve robust and conclusive results it is best to apply multiple measures to analyse liquidity changes over time since there is no universally adapted method according to Kumar and Misra (2015). One of the most used measures of liquidity is the bid-ask spread. This is the difference between the highest price that a buyer is willing to pay for an asset and the lowest price that a seller is willing to accept. Sarr and Lybek (2002) note that bid-ask spreads can be used to measure liquidity in individual exchanges and across markets, as they can give an approximation of the level of competition between buyers and sellers. Their paper link bid-ask spreads to the aspect of tightness that a liquid market display. If the spread is narrow there is less disagreement towards the value of an asset which in turn makes it easier to convert into cash or alternatively purchase the asset. This decreases the premium in place to immediately sell or purchase an asset and makes this transaction faster.

Another common method to measure liquidity is based on volume. According to Sarr and Lybek (2002) these are best used when evaluating the breadth and depth of an asset. In liquid markets this means that there are ample quantities and volumes of orders that have nominal price effects. Sarr and Lybek (2002) further explain that traders and especially dealers benefit greatly from analysing large volumes of transactions. They can gain insight from the imbalances in the order flow which can help them assess the accuracy of their prices. Changes in these quoted prices initiate order flows to counteract any price fluctuations that are not justified by the underlying fundamentals. This process gives dealers a continuous source of information to evaluate whether the price changes are permanent or fleeting. When markets lack sizable liquidity, the lack of frequent

trades can result in price discrepancies and uncertainty in regard to the equilibrium prices. Furthermore, Sarr and Lybek (2002) note that if market makers are able to spot potential buyers and sellers at ease, such as institutional investors with large portfolios, trading can be further improved. This is a significant remark in regard to this thesis since the spotting of buyers and sellers is harmed when post-trade anonymity is increased. The measures for liquidity are given with two equations by Sarr and Lybek (2002). The trading volume of an asset is used to determine the number of market participants and transactions that occur. Volume can be defined as

$$\mathrm{V} = \sum P_i * Q_i \tag{1}$$

where V is the volume traded in the specified currency, P_i is the price and Q_i the quantity in specified time period. To gain a better understanding of the meaning of trading volume, it can be related to the outstanding volume of the asset. This calculation results in the turnover rate, which indicates how frequently the outstanding volume of the asset is traded. Sarr and Lybek (2002) present this as

$$\mathrm{Tn} = \mathrm{V}/(S * P) \tag{2}$$

where Tn is the turnover rate, V is the volume defined in equation (1), S is the shares outstanding of the stock and P is the mean price of trades in equation (1).

2.4 Helsinki Stock Exchange

Stock trading activity in Finland traces its roots back to the eighteen hundreds. In the 1860s, there had already been a presence of recorded stock exchange activity in Helsinki; however, this activity had been largely unstructured and unregulated. On April 25, 1912, the governor of Uusimaa province formally sanctioned the regulations of the stock exchange, providing a framework of order and governance. In December 1997, the Helsinki Stock Exchange and the Finnish derivatives exchange called SOM combined their cash and derivatives markets to form Helsinki Exchanges. In 1998, a merger between Helsinki Exchanges and the Central Securities Depository (APK) was completed, resulting in the formation of the HEX Group. During the period 2001-2002, HEX acquired a controlling stake in the TSE Group, which comprises the Tallinn Exchange, the Estonian Securities Depository, and the Riga Stock Exchange. In 2003, OM, the parent company of the Stockholm Stock Exchange acquired HEX, resulting in the merging of the two stock exchange operators known as OMHEX. This name was shortly after changed to OMX in 2004 alongside the acquisition of the Vilnius stock exchange.

The OMX was further strengthened in 2006 when the Copenhagen Stock Exchange and the Iceland Stock Exchange joined OMX. In 2007 a multilateral trading facility called First North was established in Sweden and Finland. (Pörssisäätiö, 2010)

Historically speaking the influence that the Helsinki Stock Exchange has had on the Finnish economy could be described at least with certain metrics as minor. According to research by Nyberg and Vaihekoski (2014) the average Market Capitalization to Gross Domestic Product (MCAP-to-GDP) for the Helsinki Stock Exchange was only 15% between 1912 to 1988. This signals that during the period the stock markets influence on the Finnish economy was minuscule. However, their research also stated that this has changed in more recent times and specifically after the financial crisis of 2008 with the ratio being firmly over 50%.

The Helsinki Stock Exchange, which is officially known as the NASDAQ OMX Helsinki currently as of May 2023 has 142 listed companies. Alongside this the secondary First North market has 51 companies. The most traded and commonly regarded as the most renowned listed company in OMXH is Nokia. Companies in the Helsinki Stock Exchange are categorized into three different groups based on market capitalization forming a large, medium, and small market capitalization group. There is, however, a special fourth category which includes Special Purpose Acquisition Companies (SPACs). These are publicly traded company that are created with the sole purpose of merging with or acquiring an existing private company. As of writing this master thesis there is only one SPAC in the Helsinki stock exchange. (Nasdaq Nordic, 2022)

3 LITERATURE REVIEW

To this day it is not fully clear how post-trade anonymity and liquidity are related, although research has suggested that they can have either a beneficial or harmful effect on one another. This is dependent on multiple factors such as the stock exchange in question and the ways of determining liquidity impacts. Furthermore, the degree of anonymity provided by a stock exchange can be affected by the level of regulation, the presence of any transparency requirements, and the availability of post-trade information. The amount of anonymity may also vary depending on the type of trading taking place, as well as the types of instruments being traded. In some cases, the presence of post-trade anonymity may even result in a decrease in liquidity, as traders may feel less comfortable trading in a market where they cannot remain anonymous. There are examples in current literature of both negative and positive effects of post-trade anonymity on liquidity. These will be covered in this chapter starting with the positive ones.

Dennis and Sandås (2020) conducted research in the Nasdaq Nordics where a group of treatment and control firms switched between anonymous and transparent post-trade reporting in two independent events. This unique setup made it possible to first analyse if liquidity was affected after the change compared to the control group and then to analyse if these liquidity changes converted back when the measures were reverted. Their results can be misleading if not carefully examined since their results display an increase of spreads during the switch to anonymity. However, according to Dennis and Sandås (2020) during this time all spreads widened because of the global financial crisis and in this case the control group which remained with transparent treatment performed worse than the anonymous ones in terms of the spread. Other research that is consistent with liquidity improving under increased post-trade anonymity measures was conducted by Comerton-Forde and Tang (2009) in the Australian Stock Exchange.

Chau, Frino, Tian, and Shiguang (2012) examined effects of anonymity on cross-listed stocks in the Australian (ASX) and New Zealand Stock Exchange (NZX) respectively. Their analysis of cross-listed stocks reveals that spreads, depth, and volume increase in ASX when anonymity is increased but decrease in NZX. Similarly, liquidity improves for cross-listed stocks in NZX and deteriorate in ASX. Chau et al. (2012) argue that this indicates that anonymous trading could draw trading away from foreign exchanges and bring positive effects to the home market. Further evidence in favor of anonymity is provided by Hachmeister and Schiereck (2010). Their empirical analysis of the German Stock Exchange showed that increased anonymity leads to positive changes in the spread and order book depth therefore improving market liquidity. The findings of Friederich and Payne (2014) on the London Stock Exchange are consistent with the aforementioned research and reiterate the notion that after the application of post-trade anonymity measures liquidity increases and trade costs reduce.

Even though there is plenty of research indicating the benefits of anonymity on liquidity, the contradicting academic evidence is evident. For instance, the before cited results of Chau et al. (2012) on cross-listed stocks are consistent with Poskitt, Marsden, and Nguyen (2011) which notes that the implementation of anonymous trading by the NZX led to an enhancement in its competitive advantage against the ASX as well as a larger portion of trading in cross-listed stocks. However, Poskitt et al. (2011) finds contrasting results with the introduction of anonymous trading through broker identifier removal leading to a decrease in liquidity, as evidenced by increased effective spreads. Further evidence of similar effects is documented by Waisburd (2003). His analysis was on the effect of revealing traders' identities post-trade, using data from Euronext. The study consisted of a sample of stocks trading in two different regimes: one in which brokers' identities were revealed post-trade and one in which they were concealed. Waisburd's (2003) results showed that liquidity was smaller in the post-trade anonymous regime.

This chapter examined the current academic literature to investigate whether post-trade anonymity increases market liquidity or not. Evidence for both positions has been found, with studies showing that post-trade anonymity does lead to improved liquidity, as well as studies which demonstrate that it can have a negative impact on liquidity. As a result, this chapter concludes that the relationship between post-trade anonymity and market liquidity is not fully understood, therefore creating a research gap which needs to be filled with further research. A summary of the covered literature can be found below in Table 1.

Table 1 Summary of literature

Author(s)	Stock market	Research method	Main results
Comerton-Forde & Tang (2009)	Australia	Univariate analysis, Probit regression model	Reduced spreads of 1.64 basis points for large stocks and 26.35 for small stocks. Increased order book depth (most significant with large stocks).
Hachmeiste & Schiereck (2010)	Germany	Univariate and regression analysis	25% reduction in implicit transaction costs (market impact). Decrease in number of informed traders entering the market.
Poskitt et al. (2011)	New Zealand	Univariate and multivariate analysis	Mean bid-ask spread increases 35%. Stock prices and volumes also decreased which could have explanatory power over spread increases.
Chau et al. (2012)	Australia & New Zealand	Two-Stage Least Squares (2SLS)	Most markets experience significant improvement in spreads and depth. Liquidity flows towards the market which applies anonymity.

Waisburd (2013)	Paris	-	Liquidity reduced under a regime that adopted post-trade anonymity.
Friederich & Payne (2014)	London	Difference in differences (DiD)	Liquidity improves when measured through spreads, depth, or price impact. Most significant for smaller stocks.
Dennis & Sandås (2020)	Helsinki, Copenhagen, and Stockholm	Difference in differences (DiD)	Statistically significant 76 basis point decrease of bid-ask spread. When the change was reversed the spread increased 12 basis points (only significant for large cap stocks).
Meling (2021)	Oslo	Regression discontinuity design (RDD)	40% reduction of bid-ask spreads and 50% increased trading volume.

4 DATA AND METHODOLOGY

4.1 Data

The data for this research consists of daily stock market data from the Helsinki stock exchange during the period of 3.6.2022 to 30.5.2023. The data was obtained through Refinitiv Eikon Datastream. To analyse the liquidity impacts of the policy change four liquidity measures were devised based on past research. The main variables used to analyse liquidity were price, turnover volume, and value, bid and ask price, and shares outstanding. Further descriptions and details of these variables are explained in table 3.

Table 2 Summary of stock market data variables (Refinitiv Eikon Datastream, 2023)

Variable	Description
Price (€)	The official closing price of the stock for the day adjusted for subsequent capital actions. If the stock is listed in more than one exchange the primary exchange closing price is adopted.
Turnover volume	Number of shares traded for a stock on a particular day. Figures is expressed in thousands and is adjusted for capital events.
Bid price	The bid price for the stock that is offered at market close.
Ask price	The ask price for the stock that is offered at market close.
Turnover value	Value of all trades for the given stock on the specified day. The value is expressed in thousands and is adjusted for capital events.
Common shares outstanding	Represents the number of shares outstanding at the company's year-end. If the company has multiple stock types of the figure portrays the combined adjusted amount.
Market capitalization	Stock price multiplied by the number of ordinary shares in issue.

Using these variables further liquidity measures of bid-ask spread and Turnover Rate (Tn) were calculated. These measures and their calculations were covered more thoroughly in section 2.3. Market capitalization was used to determine the control and treatment groups. Stocks that are in the large market capitalization bracket (>€1b) are the control group since these stocks did not experience the anonymity policy change. The medium (€150m-€1b) and small (<€150m) stocks are considered the treatment group since the anonymity policy change was expanded to these stocks as of 1.12.2022. Overall, in this research there were 30 large, 52 medium, and 96 small capitalization stocks. The small capitalization group also included the stocks from the First North market since they also implemented the increased post-trade anonymity measure. Some stocks have multiple share types and for this research only the ordinary shares were considered. A few stocks were excluded from the research due to not having enough active trading days during the period or them being listed during the period. A full list of the stocks included in the research can be found in the appendix.

4.2 Descriptive statistics

The tables below present the control and treatment groups before and after the policy change of post-trade anonymity was introduced. The control group consists of large market capitalization stocks and the treatment group consists of small and medium market capitalization stocks in the Helsinki Stock Exchange.

Table 3: Control group, before treatment (3.6.2022 – 30.11.2022)

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Price	3.50	11.59	19.63	38.84	24.41	81.08
Bid- ask	0.00	100.00	300.00	500.00	484.09	28,500.00
Turnover value	0.00	1,669.00	6,907.50	16,877.75	13,451.21	990,632.00
Turnover volume	0.00	103.50	296.40	916.77	1,033.22	215,182.40
Turnover rate	0.00	0.84	1.46	2.41	2.03	55.41

Note: Figures were computed using daily closing prices from the time period. Price is in Euros, bid-ask spread is measured in basis-points, volume in thousands, and value in Euro thousands.

Table 4: Control group, after treatment (1.12.2022 - 30.5.2023)

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Price	3.69	10.52	23.22	40.18	25.94	84.98
Bid-ask	0.00	100.00	200.00	400.00	369.66	9,500.00
Turnover value	0.00	1,563.00	6,455.50	16,570.25	12,684.48	404,657.00
Turnover volume	0.00	77.82	272.65	860.27	943.42	63,673.50
Turnover rate	0.00	0.79	1.40	2.19	1.92	141.29

Note: Figures were computed using daily closing prices from the time period. Price is in Euros, bid-ask spread is measured in basis-points, volume in thousands, and value in Euro thousands.

Based on these descriptive statistics for the control group we can get a sense of the overall market conditions during the research period. Even though the control group was not affected by the policy change directly, mean bid-ask spreads experienced a decline of 100 basis points. Turnover measured in volume and value decreased and the rate at which the outstanding volume of the stock is being traded followed this decrease. These observations give us trivial information about the control group but serve as a baseline for the overall market conditions during the period.

Table 5: Treatment group, before treatment (3.6.2022 – 30.11.2022)

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Price	0.00	2.30	4.81	9.86	7.98	144.80
Bid-ask	0.00	200.00	500.00	1,300.00	1,271.98	345,500.00
Turnover value	0.00	6.00	23.00	92.00	148.90	27,984.00
Turnover volume	0.00	1.30	5.30	25.70	52.22	10,648.00
Turnover rate	0.00	0.03	0.13	0.50	0.79	246.93

Note: Figures were computed using daily closing prices from the time period. Price is in Euros, bid-ask spread is measured in basis-points, volume in thousands, and value in Euro thousands.

Table 6: Treatment group, after treatment (1.12.2022 - 30.5.2023)

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Price	0.02	2.30	4.54	9.90	7.91	118.00
Bid-ask	0.00	100.00	400.00	1,000.00	941.41	80,000.00
Turnover value	0.00	6.00	24.00	96.00	175.27	125,204.00
Turnover volume	0.00	1.30	5.60	27.80	61.01	15,434.70
Turnover rate	0.00	0.03	0.14	0.54	0.92	166.87

Note: Figures were computed using daily closing prices from the time period. Price is in Euros, bid-ask spread is measured in basis-points, volume in thousands, and value in Euro thousands.

For the treatment group the observations hold more value since these stocks adopted the increased post-trade anonymity measure. The decrease in mean bid-ask spread is 300 basis points which equates to over 23% reduction of spreads. Average turnover measured in value, volume and rate all increased after the policy change was implemented, which signals improved liquidity for these stocks. However, to fully understand what the actual effect of the policy change more robust and statistical analysis will be presented and conducted in the following chapters.

4.3 Research methodology

The research methodology for this master thesis is the difference-in-differences (DiD) method which is a quasi-experimental research design that utilizes longitudinal data from both treatment and control groups to establish a suitable counterfactual and estimate a causal effect. Its primary purpose is to assess the impact of a particular intervention or treatment, such as the implementation of a law, policy, or the introduction of a particular program. In this study we are dealing with a policy change in the Nasdaq Nordic markets which expands the post-anonymity treatment to stocks of all market capitalization sizes. The assessment of the causality effect is examined in DiD by comparing the changes in outcomes over time between the group that receives the intervention (known as the treatment group) and the group that does not (known as the control group). Therefore, we can examine the differential changes in outcomes and accurately infer the causal effect of the intervention. This method is applicable to this study since the causal effects of post-trade anonymity can be hard to estimate accurately due to there being several market wide factors which could affect the liquidity changes in the small and medium-sized stocks which do not arise from the policy change itself. The DiD method solves this problem since it helps mitigate biases that may arise when comparing the post-treatment periods of the treatment and control

groups. Moreover, the DiD method addresses biases that could arise from examining changes over time within the treatment group, which may be influenced by factors unrelated to the post-trade anonymity increase. (Columbia University Mailman School of PubHealth, 2023.)

Figure 1 presents a simple graphic example of the difference-in-differences method and shows how the groups are affected by the treatment. In this example the intervention effect is the policy change of expanding post-trade anonymity to small and medium market capitalization stocks in the Nasdaq Nordic markets. The aim is to see if the observed outcome trend is positive or negative in relation to liquidity with the applied liquidity measures. The comparison group (control group) is the large capitalization stocks which already experienced this policy change back in 2020.

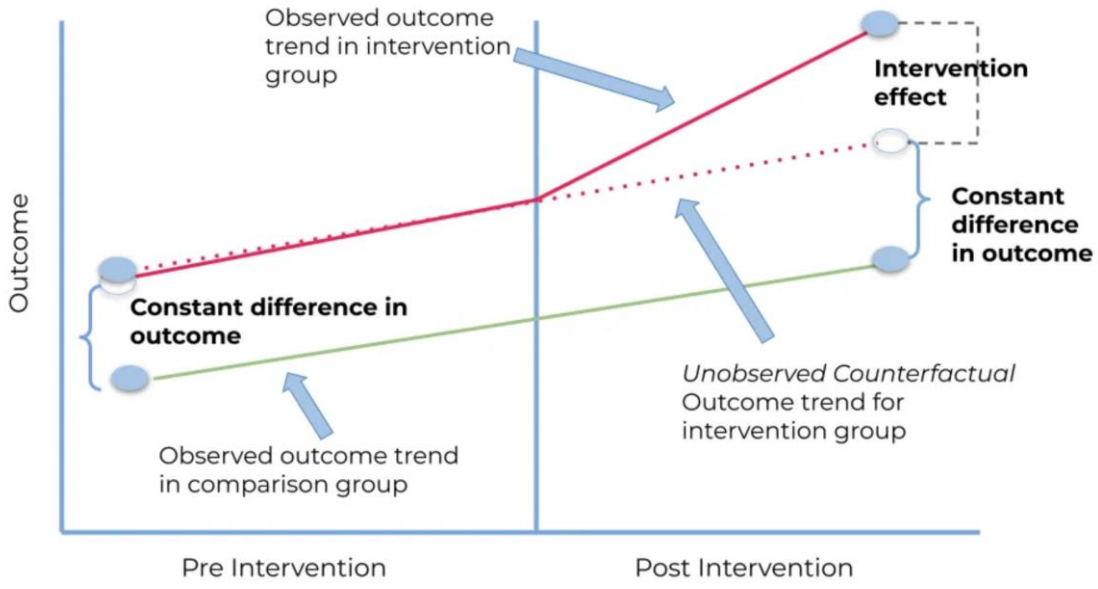

Figure 1: Difference-in-differences estimation, illustrative graphic (Columbia University Mailman School of PubHealth, 2023.)

The DiD estimation model is represented for example the following way for the bid-ask spread:

$$\text{Spread} = \beta^0 + \beta^1 * \text{Group} + \beta^2 * Treatment + \beta^3 * (Group * \text{Treatment}) + \varepsilon \quad (4)$$

In this equation the Group represents whether the observation belongs to the treatment or control group. Treatment is the indicator variable which takes the

value of 0 for before the anonymity policy change and 1 for after. The coefficients β_0, β_1, β_2, and β_3 are the parameters to be estimated in the model. They correspond to different effects: β_0 represents the intercept, β_1 represents the treatment effect, β_2 represents the time effect, and β_3 represents the interaction effect. Lastly, we have the error term ε, which captures the unobserved factors that affect the bid-ask spread but are not included in the model. To summarize, the DiD approach aims to estimate the anonymity policy change by comparing the changes in multiple liquidity measures i.e., bid-ask spread between the treatment group and the control group over time. The coefficient $\beta 3$ is especially of interest since it represents the treatment effect or the differential effect of the treatment over time. By estimating this coefficient and assessing its statistical significance, determinations of whether the treatment group experienced a significant change in liquidity compared to the control group after the policy change can be made. The same equation is applied to the other liquidity variables of value, volume, and turnover rate.

5 RESULTS AND ANALYSIS

5.1 Preliminary results

The Difference-in-Differences (DiD) models used in this chapter all return the following coefficients:

1. **Group (β_1)**: The difference between the treatment and the control group before treatment.
2. **Treatment (β_2)**: Average change over time for both the control and treatment group.
3. **Group*Time (β_3)**: Difference-in-Differences estimator, the causal effect of the treatment.
4. **Constant (β_0)**: average outcome of the control group before treatment.0

The third coefficient from these is the highest of interest since it reveals to us the effect that the post-trade anonymity increase has on the treatment group compared to the control group.

Table 7 presents the results of the DiD model for the bid-ask spread expressed in basis points. The Group coefficient is statistically significant and has a value of 787.888 ($p<0.01$) suggesting that the bid-ask spread is higher for the treatment group compared to the control group before treatment which is in line with the descriptive statistics presented earlier. This makes logical sense since the treatment group is comprised of small and medium capitalization stocks which have less liquidity than the large cap stocks of the control group. In this table the Constant coefficient is also highly statistically significant ($p<0.01$), but it only offers a baseline that represents the average bid-ask spread for the control group before the policy change which is not main interest of this analysis. The coefficient Treatment is statistically significant on a weak level ($p<0.1$) and has a value of -114.430. This signals that over the time period bid-ask spreads decrease for both the treatment and control group indicating increase liquidity.

The coefficient of interest is Group*Time which represents the causal effect of the policy change. The value of -216.138 is highly statistically significant ($p<0.01$). Since the coefficient is negative it indicates that the bid-ask spread decreased after the post-trade anonymity policy change was introduced. Moreover, this signals that the introduction of post-trade anonymity as a policy change had a statistically significant decreasing effect on the bid-ask spread for the treatment group. However, for this estimation the R-squared value is very low at the level of 0.010. This indicates that the independent variables are only able to explain 1% of the variance in the bid-ask spread. More importantly for this study the F-sta-

tistic for the estimation is highly significant ($p<0.01$) which suggests that regression model is effective in explaining the bid-ask spread and the impact of the policy change on liquidity.

Table 7: Difference-in-Differences estimation for bid-ask spread

	Dependent variable:
	Bid- ask spread
Group	787.888***
	(52.014)
Treatment	−114.430*
	(67.074)
Group*Time	−216.138***
	(73.559)
Constant	484.094***
	(47.429)
Observations	45,924
R^2	0.010
Adjusted R^2	0.010
Residual Std. Error	2,950.498 (df = 45920)
F Statistic	154.795*** (df = 3; 45920)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 8 applies the model to turnover by volume which is the number of shares traded for a stock on a particular day in thousands. Similar results akin to those seen with the bid-ask spread can also be observed when applying the DiD model to the volume of trades. The negative value of the Group coefficient ($p<0.01$) -980.996 shows that the treatment group had lower turnover measured in volume before treatment compared to the control group which is once again logical due to small and medium sized stocks being less traded than the large market capitalization stocks in control group. The model suggests that the policy change has an increasing effect on the turnover volume of treatment stocks, and that this finding is statistically significant at a high level ($p<0.01$). The negative value of -89.796 in the Treatment coefficient indicates that volume measured in number of stocks traded decreases over the measuring period, but this is however for both the treatment group and control group.

Table 8: Difference-in-Differences estimation for turnover volume

	Dependent variable:
	Turnover volume
Group	-980.996***
	(25.446)
Treatment	-89.796***
	(32.814)
Group*Time	98.577***
	(35.987)
Constant	1,033.220***
	(23.203)
Observations	45,924
R^2	0.055
Adjusted R^2	0.055
Residual Std. Error	1,443.450 (df = 45920)
F Statistic	896.366*** (df = 3; 45920)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 9 shows the regression results of the same DiD model but for turnover measured in value which is all trades for the stock during the day expressed in thousands. This model has more explanatory power ($R^2 = 0.212$) which is the highest out of the four models, but it is still not considered high. The F-statistic is once again statistically significant at a high level ($p<0.01$). The Group coefficient of -13,302.310 is highly statistically significant ($p<0.01$) and the negative value implies that the turnover measured in value is higher for the control group compared to the treatment group which is in line with expectations. In this model the coefficient Treatment is highly significant ($p<0.01$) and implies that over time whole time period the turnover measured in value decreased for both groups. The coefficient Group*Time indicates that turnover value on average increased by 793.096 for the treatment group compared to the control group after the treatment was received. This finding is also highly statistically significant ($p<0.01$).

Table 9: Difference-in-Differences estimation for turnover value

	Dependent variable:
	Turnover value
Group	-13,302.310***
	(164.422)
Treatment	-766.728***
	(212.029)
Group*Time	793.096***
	(232.528)
Constant	13,451.210***
	(149.927)
Observations	45,924
R^2	0.212
Adjusted R^2	0.212
Residual Std. Error	9,326.868 (df = 45920)
F Statistic	4,111.691*** (df = 3; 45920)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 10 showcases the DiD estimation for the turnover rate which describes how frequently the outstanding volume of the asset is traded. The R-squared for the model is very low (0.012) but the F-statistic is again highly statistically significant ($p<0.01$). The negative Group coefficient ($p<0.01$) of -1.241 supports the understanding that the treatment group has overall lower liquidity compared to the control group before treatment. We can observe a highly statistically significant ($p<0.01$) increase of 0.238 in the Group*Time coefficient which implies that the policy change of post-trade anonymity had a favorable impact on liquidity measured by the turnover rate.

Table 10: Difference-in-Differences estimation for turnover rate

	Dependent variable:
	Turnover rate
Group	-1.241***
	(0.067)
Treatment	-0.107
	(0.087)
Group*Time	0.238**
	(0.095)
Constant	2.029***
	(0.061)
Observations	45,924
R^2	0.012
Adjusted R^2	0.012
Residual Std. Error	3.820 (df = 45920)
F Statistic	189.469*** (df = 3; 45920)
Note:	*p<0.1; **p<0.05; ***p<0.01

The findings of the presented Difference-in-Differences models indicate improvement in all liquidity measures for the treatment group compared to the control group once the post-trade anonymity increase was put into force. Furthermore, these findings are all statistically significant on high levels expect for the turnover rate which can be considered as a moderate rate ($p<0.05$). After the policy change of increased post-trade anonymity was adopted, the affected group of small and medium market capitalization stocks in the Helsinki Stock Exchange experienced a decrease of more than 216 basis points in their average bid-ask spread compared to the control group. However, this represents the difference not the actual outcome. To better illustrate this, figure 2 presents the effect of the policy change on bid-ask spreads expressed in basis points in visual format.

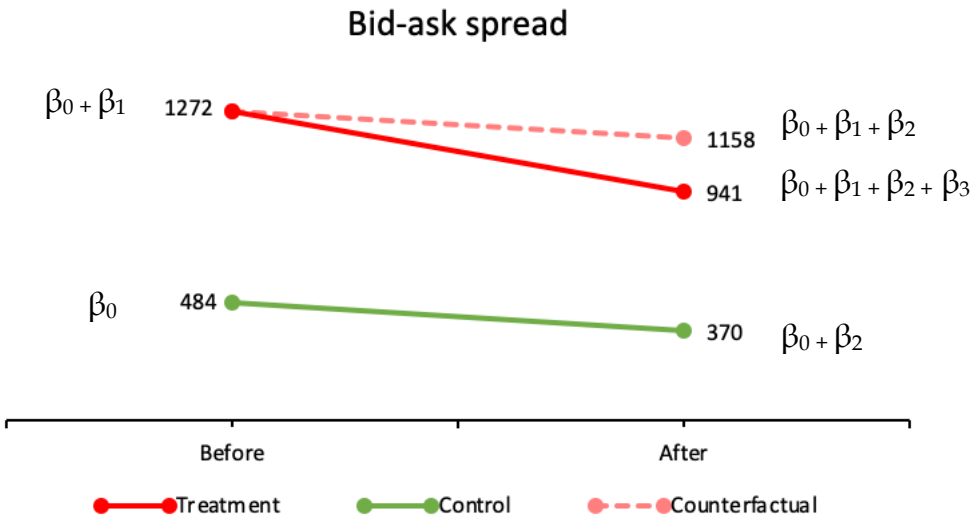

Figure 2: Difference-in-differences estimation for bid-ask spread

From this figure we can observe that both the control and treatment group experienced a decrease in bid-ask spread, which indicates improved liquidity. This effect is shown by the coefficient Treatment (β_2) which was -114.430. The starting point for both groups can be expressed as β_0 for the control group and $\beta_0 + \beta_1$ for the treatment group. The counterfactual in the figure represents what would have happened to the bid-ask spread of the treatment group if the policy change had not occurred. From the figure we can also observe the severity of the decrease in bid-ask spread measured in basis points for the groups. The bid-ask spread for the treatment group decreased by 26% and the control group by 24%. In absolute terms the decrease was 331 basis points for the treatment group and 114 for the control group. This finding is in line with for instance, Comerton-Forde & Tang (2009), Friederich & Payne (2014), Dennis & Såndas (2020), and Meling (2021) which all report a reduction in the bid-ask spreads when post-trade anonymity is adopted. To give some context the magnitude of results vary among these past researches. For instance, Meling (2001) documented a reduction of 40% in bid-ask spread in a study covering the anonymity change in the Oslo stock market. In Friederich & Payne (2014) the reduction in spreads was 20% for the London stock market.

The volume measured in number of shares traded daily increased by nearly 100 000 for the treatment group after the policy change compared to the control sample. For the euro (€) amount the value of these trades increased by nearly €800 000 for the treatment stocks compared to the control stocks after policy change. However, these figures can lead to misinterpretation since these are figures compared against the control group. The control group experienced a decrease in both turnover by volume and value during the period. Since the treatment group increased in traded volume and value the difference can be easy to misunderstand. Nevertheless, the results are significant since when the large stocks decreased in traded volume and value the smaller stocks affected by the

post-trade anonymity measure increased by 9000 in average daily traded volume and €26 000 in average daily traded value.

Similar results are observed with the frequency with which the outstanding volume of the treatment stocks is being traded. An increase of 0.238 is observed when comparing to the control group after the policy change was implemented. Once again, the control group turnover rate decreased while for the treatment group it increased by 0.1 (17%). Table 11 presents the impacts of the policy change on the selected liquidity measure of both the treatment and control group.

Table 11: Effects of post-trade anonymity policy change

Treatment	Effect size	-%
spread (bp)	330.6	-26.0%
volume (k)	8.8	16.8%
value (€k)	26.4	17.7%
rate	0.1	16.6%
Control		
spread (bp)	114.4	-23.6%
volume (k)	-89.8	-8.7%
value (€k)	-766.7	-5.7%
rate	-0.1	-5.3%

In chapter 1.2 the research question: "*What is the impact of increased post-trade anonymity on liquidity in the Helsinki stock exchange?*" was established. Through the analysed Difference-in-Differences models we can conclude that on a highly statistically significance level the bid-ask spread experienced a decrease measured in basis points when compared to the control group after post-trade anonymity was being applied. Furthermore, trading increased in terms of volume, value, and frequency of outstanding volume being traded for the treatment group compared to the control group after the policy change at a highly statistical significance level. What is especially noteworthy is that the liquidity measures related to turnover observed to decline with the large capitalization stocks but increase with the small and medium sized stocks.

These findings provide meaningful economic and statistical evidence to the notion that introducing post-trade anonymity positively enhanced liquidity for small and medium market capitalization stocks, supporting the effectiveness of the policy change in improving market conditions for these assets.

5.2 Analysis of small and medium capitalization stocks

The results presented in chapter 5.1 were conducted with small and medium capitalization stocks combined forming the treatment group and large capitalization stocks forming the control group. In this chapter small and medium cap stocks are examined separately to further investigate how the policy change affected liquidity amongst these groups. The same DiD estimation were conducted individually for the small capitalization group with large cap stocks producing the control group and likewise for the medium capitalization stocks. The purpose of this is to gain insight and answers to the sub-research questions: "Do the effects vary between small and medium market capitalization stocks?" which was defined in chapter 1.2.

To adequately illustrate this the tables 12 presents the absolute results of the familiar DiD model which has been changed to now have small and medium capitalization stocks as the treatment group separately. The DiD regression results for all four liquidity measures can be found in Appendix 1. For the bid-ask spread we can observe that medium-sized stocks experienced a large decrease in spread indicating increased liquidity. For the turnover measured in volume both sizes encountered roughly equal effect in absolute terms, but the percentage change was much greater with smaller stocks since they are naturally less traded than medium sized ones. Furthermore, the increase in turnover by volume was not statistically significant for the medium cap stocks whereas for the small cap stocks the increase was statistically significant at a level of $p<0.05$. For the turnover measured in value the effects for both groups were relatively similar in isolation. Naturally, the euro amount for the increased daily traded average value was much greater for medium-sized stocks due to their size and volume differences. In terms of the turnover rate the difference in increase was noticeable. Small cap stocks experienced a far greater increase in frequency in which their outstanding volume is traded compared to medium sized stocks. Moreover, the increase in turnover rate was only statistically significant for the small cap stocks.

Table 12: Effects of post-trade anonymity policy change (Small & Medium cap)

Small cap	Effect size	-%
spread (bp)	316.9	-23.9%
volume (k)	8.9	29.9%
value (€k)	6.9	20.4%
rate	0.2	29.1%
Medium cap		
spread (bp)	355.9	-30.3%
volume (k)	8.5	9.1%
value (€k)	62.3	17.2%
rate	0.0	1.3%
Control		
spread (bp)	114.4	-23.6%
volume (k)	-89.8	-8.7%
value (€k)	-766.7	-5.7%
rate	-0.1	-5.3%

All in all, while the policy change effects were quite noticeable in both size groups, the more pronounced overall effect is observed with small capitalization stocks which consistent to the overall results of Friederich & Payne (2014). The increase in volume and turnover rate was more intense both statistically and economically and when relating the value to the size of the group the increase was also greater. Medium capitalization stocks did, however, have an economically more significant decrease in the bid-ask spread. Interestingly, past studies such as Friederich & Payne (2014) and Dennis & Såndas (2020) observe that the improvement in bid-ask spreads was more prolific in smaller companies with direct relations to firm size. In this study this was not quite the case since medium sized stocks experienced a larger reduction in bid-ask spreads compared to small stocks.

These findings give insight into the sub-research question which set out to investigate if differences between liquidity effects emerged between small and medium-sized stocks. Overall, the answer is yes and with small market capitalization stocks experiencing larger liquidity improvements than medium-sized stocks.

6 CONCLUSIONS

This thesis set out to examine the effects of post-trade anonymity on liquidity in the Helsinki Stock Exchange. The Nasdaq Nordic markets experienced an increase in post-trade anonymity when this measure was expanded from large capitalization stocks to also cover small and medium market capitalization stocks in late 2022. The effects on liquidity were investigated through a difference-in-differences (DiD) model which was applied to liquidity measures of bid-ask spread, turnover volume, turnover value, and turnover rate. Past research on the subject has suggested that increased post-trade anonymity has positive effects on liquidity as demonstrated by Comerton-Forde & Tang (2009), Friederich & Payne (2014), Dennis & Såndas (2020), and Meling (2021).

The empirical results from the DiD model suggest that while both the control and treatment groups experienced an increase in liquidity measured by the bid-ask spread the effect was more significant with the treatment group. More specifically the bid-ask spread tightened by 331 basis points for the treatment group when the comparable decrease was 114 basis points for the control group. When examining the turnover measured in average daily traded volume both statistically and economically significant findings are observed. While the volume decreased for the large market capitalization stocks in the control group by 8.7% the treatment group saw an increase of 16.8% which translates to 9 000 in average daily traded volume. Similar findings are revealed by the DiD model when examining the turnover measured in value. Once again, the control group's daily traded value dropped when the treatment group experienced an increase of 17.7% which equates to a value of 26 000€. To give some context to these findings and their economic significance the mean turnover volume for the treatment group was 26 000€ before the policy change was adopted and the corresponding turnover value was 92 000€. Finally, the turnover rate, which measures the rate at which the outstanding volume of the asset is being traded daily, signaled an increased liquidity for the treatment group. This increase was 16.6% while simultaneously the control group's turnover rate decreased by 5.3%.

Further examination of these liquidity increases in the treatment group was done by separating the small and medium market capitalization stocks from each other to investigate if the firm size had any effects on the liquidity increase. This revealed that liquidity increases were more severe in the small capitalization stocks. Moreover, the increase in volume and turnover rate was more significant both statistically and economically for the small stocks compared to the medium-sized stocks. However, the medium-sized stocks did in fact experience a more economically significant decrease in the bid-ask spread.

These findings are relevant for several reasons. First, they shed light on the ongoing debate over increased anonymity measures in the Nasdaq Nordic Stock Exchange's that has surfaced due the recent policy changes. Second, they are in line and support past research of Comerton-Forde & Tang (2009), Friederich &

Payne (2014), Dennis & Såndas (2020), and Meling (2021). Third, they provide policy makers and stock exchange regulators statistically and economically significant evidence to the benefits of post-trade anonymity in terms of liquidity and ultimately market efficiency. However, further research has to be conducted to better understand the effects of post-trade anonymity on liquidity.

This research faces some limitations due to the nature of the research and its scope. For example, the control and treatment groups could have experienced some changes post-treatment since the market capitalizations of stocks fluctuate every day. For instance, the OMXH25 index inspects the 25 largest stocks by market capitalization bi-annually in the Helsinki Stock Exchange. Possible liquidity effects of stocks being included in major indexes during the examination period should be taken into account in further research. Another limitation concerns the liquidity measures used in the research. To better understand how post-trade anonymity affects liquidity more liquidity measures should be devised to provide more robust results. Furthermore, increasing the examination period could capture the longer-term effects of the policy change for the control and treatment group. To increase the robustness of the results additional control groups should be devised to support the findings of this thesis. For example, other control groups could consist of stocks from the Oslo stock exchange since it holds similar characteristics to the Helsinki stock exchange and post-trade anonymity is already adopted there.

REFERENCES

Åkerblom, T. (2022, November 30). Likviditeetti räjähtää ja markkina tehostuu entisestään. https://www.sijoitustieto.fi/sijoitusartikkelit/likviditeetti-rajahtaa-ja-markkina-tehostuu-entisestaan

Amihud, Y., & Mendelson, H. (1986). Liquidity and stock returns. Financial Analysts Journal, 42(3), 43-48.

Baker, H. K. (1996). Trading location and liquidity: An analysis of US dealer and agency markets for common stocks. Blackwell Pubs.

Bloomfield, R., & O'Hara, M. (1999). Market transparency: who wins and who loses?. The Review of Financial Studies, 12(1), 5-35.

Cave, T. (2013). Nasdaq mulls anonymity for high-speed firms in Nordics. Financial News. https://www.fnlondon.com/articles/nasdaq-mulls-anonymity-for-high-speed-firms-nordics-20131029

Comerton-Forde, C., & Tang, K. M. (2009). Anonymity, liquidity and fragmentation. Journal of Financial Markets, 12(3), 337-367.

Comerton-Forde, C., Putniņš, T. J., & Tang, K. M. (2011). Why do traders choose to trade anonymously?. Journal of Financial and Quantitative Analysis, 46(4), 1025-1049.

Chau, J., Frino, A., Tian, G. G., & Ma, S. (2012). Impact of anonymity on liquidity in limit order books: evidence from cross-listed stocks. In 25th Australasian Finance and Banking Conference.

Christopherson, K. M. (2007). The positive and negative implications of anonymity in Internet social interactions: "On the Internet, Nobody Knows You're a Dog". Computers in Human Behavior, 23(6), 3038-3056.

Dennis, P. J., & Sandås, P. (2020). Does trading anonymously enhance liquidity?. Journal of Financial and Quantitative Analysis, 55(7), 2372-2396.

Difference-in-difference estimation. Columbia University Mailman School of PubHealth. (2023). https://www.publichealth.columbia.edu/research/population-health-methods/difference-difference-estimation

Fang, V. W., Noe, T. H., & Tice, S. (2009). Stock market liquidity and firm value. Journal of financial Economics, 94(1), 150-169.

Friederich, S., & Payne, R. (2014). Trading anonymity and order anticipation. Journal of Financial Markets, 21, 1-24.

Frino, A., Johnstone, D., & Zheng, H. (2010). Anonymity, stealth trading, and the information content of broker identity. Financial Review, 45(3), 501-522.

Garfinkel, J. A., & Nimalendran, M. (2003). Market structure and trader anonymity: An analysis of insider trading. Journal of Financial and Quantitative Analysis, 38(3), 591-610.

Hachmeister, A., & Schiereck, D. (2010). Dancing in the dark: post-trade anonymity, liquidity and informed trading. Review of Quantitative Finance and Accounting, 34, 145-177.

Helsingin pörssi - NASDAQ OMX Helsinki - Osakkeet Ja indeksit. (2022, March 28). Osakesijoittaja.fi. https://osakesijoittaja.fi/osakesijoittaminen/helsingin-porssi-omxh/

History of the Finnish stock market. (2010, November 5). Pörssisäätiö. https://www.porssisaatio.fi/en/blog/2010/11/05/history-of-the-finnish-stock-market/

International Swaps and Derivatives Association. (2020). Review of the MIFID II/MIFIR Framework. Retrieved from https://www.isda.org/a/gvbTE/Review-of-the-MIFID-II-MIFIR-Framework.pdf

Keynes, J. M. (1930). Treatise on money: Pure theory of money Vol. I.

Kumar, G., & Misra, A. K. (2015). Closer view at the stock market liquidity: A literature review. Asian Journal of Finance and accounting, 7(2), 35-57.

Lehtinen, J. (2022). Valittajatietojen poistaminen osakekaupoista harmittaa sijoittajia - Helsingin pörssin Henrik Husman kertoo miksi päätös tehtiin. Kauppalehti. https://www.kauppalehti.fi/uutiset/valittajatietojen-poistaminen-osakekaupoista-harmittaa-sijoittajia-helsingin-porssin-henrik-husman-kertoo-miksi-paatos-tehtiin/8f45325e-19c2-49c0-8510-7af585a77ee3?ref=twitter%3A55bc

Meling, T. G. (2021). Anonymous trading in equities. The Journal of Finance, 76(2), 707-754.

Markets in Financial Instruments Directive II (MiFID II). (2020).

Naik, N. Y., Neuberger, A., & Viswanathan, S. (1999). Trade Disclosure Regulation in Markets with Negotiated Trades. Review of Financial Studies, 12(4), 873–900. https://doi.org/10.1093/rfs/12.4.873

Nasdaq Nordic. (2022). Nasdaq Nordic. https://www.nasdaq.com/nordic-market

Nyberg, P. M., & Vaihekoski, M. (2014). Descriptive analysis of the Finnish stock market: Part II. Bank of Finland Research Discussion Paper, (10).

O'Hara, M. (1995). Market microstructure theory. Basil Blackwell, Oxford.

O'Hara, M. (2004). Liquidity and financial market stability. National Bank of Belgium Working Paper, (55).

Poskitt, R., Marsden, A., Nguyen, N., & Shen, J. (2011). The introduction of broker anonymity on the New Zealand Exchange. Pacific Accounting Review, 23(1), 34-51.

Sarr, A., & Lybek, T. (2002). Measuring Liquidity in Financial Markets. IMF Working Paper No. 02/232. https://ssrn.com/abstract=880932.

Saporta, V., Trebeschi, G., & Vila, A. (1999). Price Formation and Transparency on the London Stock Exchange. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.162628

Securities and Exchange Comission. (2005). Regulation NMS: National market system. Retrieved from https://www.sec.gov/rules/final/34-51808.pdf

Securities Investment Board (SIB), (1994). Regulation of the United Kingdom Equity Markets. SIB. London.

Swee, Å. (2022). Ekka Lundin om anonymiserad aktiehandel: Det går åt fel håll. Affärsvärlden. https://www.affarsvarlden.se/artikel/ekka-lundin-om-anonymiserad-aktiehandel-det-gar-at-fel-hall

Waisburd, A. C. (2003). Anonymity and liquidity: evidence form the Paris Bourse. working paper, Neeley School of Business.

APPENDIX 1 Difference-in-differences estimations for small and medium market capitalization stocks

Table 13 Difference-in-differences estimation for small cap bid-ask spread

	Dependent variable:
	Bid-ask spread (Small cap)
Group	840.348***
	(50.020)
Treatment	-114.430*
	(61.746)
Group*Time	-202.425***
	(70.739)
Constant	484.094***
	(43.661)
Observations	32,508
R^2	0.016
Adjusted R^2	0.016
Residual Std. Error	2,716.129 (df = 32504)
F Statistic	174.802*** (df = 3; 32504)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 14 Difference-in-differences estimation for small cap turnover volume

	Dependent variable:
	Turnover volume (Small cap)
Group	−1,003.432***
	(31.303)
Treatment	−89.796**
	(38.641)
Group*Time	98.705**
	(44.269)
Constant	1,033.220***
	(27.324)
Observations	32,508
R^2	0.054
Adjusted R^2	0.054
Residual Std. Error	1,699.786 (df = 32504)
F Statistic	621.156*** (df = 3; 32504)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 15 Difference-in-differences estimation for small cap turnover value

	Dependent variable:
	Turnover value (Small cap)
Group	−13,417.360***
	(202.946)
Treatment	−766.728***
	(250.522)
Group*Time	773.623***
	(287.010)
Constant	13,451.210***
	(177.146)
Observations	32,508
R^2	0.203
Adjusted R^2	0.202
Residual Std. Error	11,020.140 (df = 32504)
F Statistic	2,751.470*** (df = 3; 32504)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 16 Difference-in-differences estimation for small cap turnover rate

	Dependent variable:
	Turnover rate (Small cap)
Group	−1.363***
	(0.076)
Treatment	-0.107
	(0.094)
Group*Time	0.301***
	(0.108)
Constant	2.029***
	(0.067)
Observations	32,508
R^2	0.016
Adjusted R^2	0.016
Residual Std. Error	4.147 (df = 32504)
F Statistic	172.971*** (df = 3; 32504)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 17 Difference-in-differences estimation for medium cap bid-ask spread

	Dependent variable:
	Bid-ask spread (Medium cap)
Group	691.039***
	(56.417)
Treatment	−114.430*
	(63.535)
Group*Time	−241.456***
	(79.785)
Constant	484.094***
	(44.926)
Observations	21,156
R^2	0.012
Adjusted R^2	0.012
Residual Std. Error	2,794.838 (df = 21152)
F Statistic	87.336*** (df = 3; 21152)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 18 Difference-in-differences estimation for medium cap turnover volume

	Dependent variable:
	Turnover volume (Medium cap)
Group	−939.575***
	(42.707)
Treatment	−89.796*
	(48.097)
Group*Time	98.341
	(60.397)
Constant	1,033.220***
	(34.009)
Observations	21,156
R^2	0.040
Adjusted R^2	0.039
Residual Std. Error	2,115.700 (df = 21152)
F Statistic	290.965*** (df = 3; 21152)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 19 Difference-in-differences estimation for medium cap turnover value

	Dependent variable:
	Turnover value
Group	−13,089.910***
	(277.335)
Treatment	−766.728**
	(312.331)
Group*Time	829.045**
	(392.211)
Constant	13,451.210***
	(220.851)
Observations	21,156
R^2	0.165
Adjusted R^2	0.165
Residual Std. Error	13,739.010 (df = 21152)
F Statistic	1,394.615*** (df = 3; 21152)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 20 Difference-in-differences estimation for medium cap turnover rate

	Dependent variable:
	Turnover rate
Group	−1.363***
	(0.076)
Treatment	-0.107
	(0.094)
Group*Time	0.301***
	(0.108)
Constant	2.029***
	(0.067)
Observations	32,508
R^2	0.016
Adjusted R^2	0.016
Residual Std. Error	4.147 (df = 32504)

F Statistic	172.971^{***} (df = 3; 32504)
Note:	*p<0.1; **p<0.05; ***p<0.01

APPENDIX 2 LIST OF COMPANIES USED IN THE RESEARCH

Small capitalization stocks

AFARAK GROUP
AIFORIA TECHNOLOGIES
APETIT
ASUNTOSALKKU
BITTIUM
BOREO
CONSTI
EEZY
ENERSENSE INTERNATIONAL
GLASTON
ILKKA
LAMOR CORPORATION
LEMONSOFT
LIFELINE SPAC I
LOIHDE
MODULIGHT
MULTITUDE
NIXU
NOHO PARTNERS
NORDIC LIGHTS GROUP
ORTHEX
SIILI SOLUTIONS
UNITED BANKERS
VERKKOKAUPPA COM
VINCIT
WETTERI
AALLON GROUP
ADMINISTER
ALEXANDRIA GROUP
ALISA BANK ORD
ASPOCOMP GROUP
BBS-BIOACTIVE BONE SUBSTITUTES
BETOLAR
BIOHIT B
BIORETEC
COMPONENTA
DIGITAL WORKFORCE SERVICES
DIGITALIST GROUP
DOVRE GROUP
DUELL
EAGLE FILTERS GROUP
ECOUP

EFECTE
ELECSTER
ENEDO
EXEL COMPOSITES
FIFAX
FODELIA
FONDIA
HEEROS
HERANTIS PHARMA
HKSCAN
HONKARAKENNE
INDERES
INNOFACTOR
INVESTORS HOUSE
KESKISUOMALAINEN
KESLA A
KH GROUP
KREATE GROUP
LAPWALL
LEADDESK
LEHTO GROUP
LIFA AIR
MARTELA A
MERUS POWER
NETUM GROUP
NEXSTIM
NIGHTINGALE HEALTH
NORRHYDRO GROUP
NURMINEN LOGISTICS
OPTOMED
OVARO KIINTEISTOSIJOITUS
PANOSTAJA
PARTNERA
PIIPPO
PUNAMUSTA MEDIA
QPR SOFTWARE
RAUTE
REKA INDUSTRIAL
ROBIT
RUSH FACTORY
SAGA FURS
SOLTEQ
SOLWERS
SPRINGVEST
SRV YHTIOT
SSH COMMUNICATIONS SECURITY
TELESTE
TOIVO GROUP

TRAINERS HOUSE
TULIKIVI
VALOE
VIAFIN SERVICE
WITTED MEGACORP
WULFF-GROUP

Medium cap stocks

AKTIA BANK
INCAP
WITHSECURE
ADMICOM
ALANDSBANKEN
ALMA MEDIA
ANORA GROUP
ASPO
ATRIA
CAPMAN
CAVERION
DETECTION TECHNOLOGY
DIGIA
ENENTO GROUP
EQ
ETTEPLAN
EVLI
F SECURE OYJ
FINNAIR
GOFORE
HARVIA
KAMUX
LASSILA & TIKANOJA
MARIMEKKO
MUSTI GROUP
NANOFORM FINLAND
NYAB
OLVI
OMA SAASTOPANKKI
ORIOLA
PIHLAJALINNA
PONSSE
PURMO GROUP
PUUILO
RAISIO
RAPALA VMC
RELAIS GROUP
REMEDY ENTERTAINMENT

ROVIO ENTERTAINMENT
SCANFIL
SITOWISE GROUP
SPINNOVA
STOCKMANN
SUOMINEN
TAALERI
TALENOM
TECNOTREE
TERVEYSTALO
TITANIUM
TOKMANNI GROUP CORP.
VIKING LINE
YIT

Large cap stocks

NESTE
NOKIA
SAMPO
KONE
UPM-KYMMENE
FORTUM
METSO CORPORATION
ELISA
STORA ENSO
CARGOTEC
CITYCON
FISKARS
HUHTAMAKI
KEMIRA
KEMPOWER
KESKO
KOJAMO
KONECRANES
METSA BOARD
NOKIAN RENKAAT
ORION
OUTOKUMPU
QT GROUP
REVENIO GROUP
SANOMA
TIETOEVRY
UPONOR
VAISALA
VALMET
WARTSILA

APPENDIX 3 DISCLOUSURE ON ARTIFICIAL INTELLIGENCE TOOLS

The work done in this thesis was supported by artificial intelligence tools, more specifically ChatGPT developed by OpenAI. The tool was used for improving the coherence and structure of the language in this thesis mostly through rephrasing and optimizing sentences. Furthermore, AI-tools were utilized in the statistical analysis to check, validate, and improve the code used in R and LaTeX. The usage of ChatGPT in these specific contexts aimed to enhance the quality and effectiveness of this master thesis. The AI tool served as a valuable resource for language improvement, code validation, code optimization, and communication clarity within the thesis, all while taking precautions to prevent plagiarism.

It is important to note that while ChatGPT played a role in these aspects, the research, analysis, and conclusions presented in this thesis remain the result of human effort and expertise, with ChatGPT serving as a complementary tool to aid in the writing and validation process.