Stockholm School of Economics
Department of Accounting and Financial Management
Bachelor Thesis in Accounting and Financial Management
May 2023

Stock Splits' Impact on Liquidity Under Current Market Conditions

A study on the liquidity effects of share splits in a modern Swedish setting

Ludvig Völcker (25063) *Lowiza Svensson (25058)*

Abstract

This study examines whether stock splits still improve liquidity under current market conditions. To do so, we conduct three t-tests to examine changes in the bid-ask spread, turnover in relation to market capitalization, and Amivest Liquidity Ratio, around 64 share splits on Nasdaq Stockholm between 2013 and 2022, both for individual firms and on a general level. The study finds no support for improved liquidity in the long term after a split under current market conditions, in contrast to much of the previous literature performed on larger, historical data sets. The overrepresentation of higher split ratios in the most improved firms however suggests that there still exists an optimal trading range where liquidity is maximized, but that the required frequency of splits to stay within the range may be significantly smaller under current market conditions.

Tutor: Henrik Andersson

Keywords: Splits, Liquidity, Signaling, Optimal trading range, Nasdaq Stockholm

Acknowledgements: We would like to thank our tutor, Henrik Andersson, for the guidance throughout this process, and our tutor group for valuable inputs.

Table of Contents

1. Introduction

1.1 Background

The average US nominal share price has been close to constant since the 50s despite the accumulated inflation, as a result of regularly executed share splits. Splits are carried out by companies when the share price is considered to have reached too high levels, in order to return to the so-called optimal trading range (Anshuman and Kalay, 2002).

In theory, share splits should be purely cosmetic and have no impact on the value of the firm (Muscarella and Vetsuypens, 1996). In reality, however, the announcements of splits often lead to positive share price reactions (Chakraborty et al., 2020; Fama et al., 1969; Gupta and Arya, 2020; Pandey et al., 2021). Baker and Gallagher (1980) reported that 94% of firms split their shares to return to an optimal trading range where liquidity is maximized, whilst Brennan and Copeland (1988) argued that it is a way to signal favorable information. Research over the years has found evidence advocating both for and against the liquidity- and signaling hypotheses in relation to share splits, with different reasoning behind firms' rationale to split their share.

Liquidity is a necessary issue to consider for managers who wish to maximize shareholder value as a liquid share facilitates a fair valuation of the firm, which in turn brings value to its shareholders (Amihud and Mendelson, 1986; Brennan and Subrahmanyam, 1995). Lower liquidity affects asset pricing as it leads to a higher required yield to account for the higher levels of trading friction and transaction costs (Amihud and Mendelson, 1986). Thus, firms have incentives to increase the liquidity of the stock to reduce the opportunity cost of capital, which in turn has the potential of increasing the value of the firm.

The Swedish trading market conditions have significantly changed over the years and were subject to several impactful changes during the 00s. In 2007, a new legislation called MiFID (Markets in Financial Instruments Directive) started to be gradually enforced in the European Union with the intention to make financial markets more efficient, resilient, and transparent. The regulation concerns, among other things, the provision of services in financial instruments by banks, which brought competition and in turn lower prices for investors (European Commission, n.d.). Moreover, technical standards were developed to ensure the

orderly functioning of markets in terms of prices, spreads, and depth of liquidity in financial instruments (European Securities and Markets Authority, n.d.). These changes to the market environment should in theory have reduced the so-called microstructure phenomena that could explain the liquidity benefits from splits in the past, but they are still executed relatively frequently amongst the Swedish firms.

We investigate whether there still exists liquidity benefits with share splits in the Swedish setting, or if the value only stems from the signaling associated with them. The question is important for decision-makers and investors to understand, as the action taken might not have the same outcome in today's market as it had in the past. Thus, our research question is:

What are the effects of stock splits on liquidity under modern market conditions in the Swedish setting?

1.2 Purpose & Contribution

We contribute to the existing literature in two ways. Firstly, whilst most studies related to share splits have looked at the US and other large markets (Anshuman and Kalay, 2002; Baker and Powell, 1992; Copeland, 1979), we examine the Swedish setting where the question in hand has been relatively unexplored. Secondly, we study a more recent time frame by limiting our study period to share splits performed from 2013 to capture the significant changes in market conditions that were made in the Swedish market during the 00s. The limitation of the market and time frame provides further insights into how the market conditions of today might decrease the effects on liquidity following share splits. As many of the changes in Swedish market conditions stem from the European legislation MiFID, our contribution is of relevance to other European markets as well.

1.3 Scope

We limit our study to firms that were listed on Nasdaq Stockholm and performed a share split between January 2013 and February 2022. We include no reverse splits or splits with redemption and limit our study to only look at the liquidity following splits, not the share price performance.

1.4 Disposition

The study is structured into seven sections. In section 2, the development of market conditions in Sweden during recent years is presented, followed by existing literature on liquidity effects around share splits. Section 3 describes the methodology that has been used for the study and outlines the hypotheses to be tested. In section 4, summary statistics for the observation and control firms and the empirical results of the different tests are presented. In section 5, the results are discussed and are put in relation to previous literature. The conclusions of our findings are presented in section 6, and suggestions for future research are discussed in section 7.

1.5 Definition of Terms

Term	Definition	Source
Brokerage fees	A fee or commission charged by the broker to execute a transaction	Sharkey, 2022
Limit order	An order to buy or sell a stock at a specified price. The order will be executed immediately when it is met at the specified price or better	Nasdaq, n.d.(a)
Tick size	The minimum increments by which a stock can be quoted	Nasdaq, 2019
Microstructure phenomena	The effects on liquidity following a split caused by microstructures in the market	Maloney and Mulherin, 1992
Order depth	The quantities of orders on each price level in the order book	Nasdaq, n.b.(b)
Optimal trading range	A theoretical share price where liquidity is maximized	Copeland, 1979
Lot size	The minimum quantity set for a security that may be entered in the trading system as a transaction order	Nasdaq, n.d.(c)
Price-and-time order-prioritizing rule	Orders are executed on the best price, and if multiple orders are at the same price, the order that was placed first trades first	NYSE, n.d.

2. Theoretical Framework

This section presents the theory constituting the basis for this study. First, changes in Swedish market conditions that may impact the effects of splits are presented. After that, earlier studies on market reactions around splits are presented, as well as the main hypotheses suggested to explain them.

2.1 Development of Market Conditions in Sweden

2.1.1 Tick Sizes

In the Swedish market, the tick size has been subject to changes following the gradual incorporation of MiFID initiated in 2007 (European Commission, 2017). Today the tick size depends on the price and number of daily transactions, where a lower stock price and a higher number of daily transactions both lead to a smaller tick size. The standards for tick sizes were developed to ensure the orderly functioning of markets in terms of prices, spreads, and depth of liquidity (European Securities and Markets Authority, n.d.). Before the EU standards for tick sizes were incorporated into the Swedish market, they had followed a decreasing trend due to different trading venues competing in offering the lowest one on the market (Tomas Karlsson, 2018). The fall of 2009 was reported to be a period of "revolution", due to the competition continuously pushing tick sizes down (Jacob Bursell, 2009). Industry experts saw both advantages, where smaller bid-ask spreads following decreased tick sizes could be beneficial for small investors, but also downsides in that it could constitute problems for institutional investors as smaller tick sizes make it harder to find volumes in the order books.

2.1.2 Fees

MiFID additionally had intentions to increase competition concerning trading services in order to lower prices for investors (European Commission, n.d.). It also came with requirements that trades should be done under best execution, or equated to the best price, which was expected to result in high competition (Finansmarknadsrådet, 2008). Since then, niche banks have started to increase competition by heavily decreasing brokerage fees, forcing large banks to lower fees as well (Konkurrensverket, 2023). Apart from lower brokerage fees in general, banks today calculate fees proportional to transaction value per order, a fixed fee per order, or a combination of them both (Avanza Bank, n.d.; Danske bank,

n.d.; Handelsbanken, n.d.; Länsförsäkringar, n.d.; Nasdaq, 2022; Nordea, n.d.; Nordnet, n.d.; Pareto Securities, n.d.; SEB, n.d.; Skandiabanken, n.d.; Swedbank, n.d.).

2.1.3 Lot Sizes

In September 2008, lot sizes were removed from the Swedish market, making it possible to buy one single stock without having to go through the book of small orders (Björn Suneson, 2008). Before, one lot typically consisted of a few hundred stocks, which commonly implied a cost of around 10,000 SEK – 20,000 SEK for the minimum order. According to the CEO of the Stockholm Stock Exchange in 2008, Erik Thedéen, this change in regulations would make trading easier for small investors but also be appreciated by larger investors as the lot size was considered to be an unnecessary complication (ibid).

2.2 The Signaling Hypothesis

Capital markets are to a wide extent considered to be effective, meaning that the price of a stock should reflect all available information (Fama, 1970). This theory implies that abnormal returns can not be explained by the market return and should therefore not exist in perfect markets. Hence a split, which should only be a cosmetic change in the number of outstanding shares and thus the pricing of these, should not have any effect on the value of the firm (Muscarella and Vetsuypens, 1996). Despite this, abnormal returns around both split announcement dates and split execution dates are well documented by several researchers (Chakraborty et al., 2020; Fama et al., 1969; Gupta and Arya, 2020; Pandey et al., 2021).

One explanation for the positive share price reactions is the signaling hypothesis, which suggests that a split not only is a cosmetic change, but a way for the management to signal favorable information about the company's future (Brennan and Copeland, 1988; Brennan and Hughes, 1991; Fama et al., 1969; Ikenberry and Ramnath, 2002; McNichols and Dravid, 1990; Woolridge and Chambers, 1983). Fama et al. (1969) were among the first to acknowledge the effective market hypothesis, but also one of the pioneers in finding that a split can not only be cosmetic due to the subsequent market reaction. Instead, they argue that a split comes with new information as earnings and/or dividends tend to increase following a split, justifying the positive market reaction in line with the effective market hypothesis. The arrival of new information can in turn affect liquidity metrics such as the bid-ask spread in the short term since the buyers and sellers grow more confident about the fair valuation of the

firm. This effect on the bid-ask spread is documented by, among others, Ahn et al. (2007) who observe a larger spread at the beginning and end of the trading day when information asymmetry is higher, and a smaller spread mid-day when information asymmetry is lower.

Another common explanation supporting the signaling hypothesis is that a share split is an action taken to signal that the firm is undervalued (Brennan and Hughes, 1991). Trading at a lower price has historically given analysts increased incentives to pay attention to the company as brokerage fees used to be based on the number of shares traded. Gaining more attention from analysts could reveal information about undervaluation, which would push the share price to fair levels. The signaling value stems from the type of firms that choose to split their share, as the decision to split under that notion only will be taken by firms that are undervalued and have favorable information to reveal (ibid).

2.3 The Liquidity Hypothesis

Another explanation for the positive market reaction to a stock split is the suggestion that there is an optimal trading range that generates maximum liquidity (Conrad and Conroy, 1994; Grinblatt et al., 1984; Maloney and Mulherin, 1992). Unlike the signaling hypothesis, the liquidity hypothesis suggests that effects will occur after the execution date of the split, but also that the effect will have long-term implications. The existence of microstructure phenomena following a split could explain excess stock returns connected to the split date rather than the announcement date (ibid).

Historical studies provide somewhat contradictory results on the liquidity effects following a share split, but most favor the liquidity hypothesis suggesting a long-term positive impact. Many studies find support for the liquidity hypothesis by observing improvements in one or several measures following splits performed historically, such as the number of traders, bid-ask spreads, and trading volume (Baker and Powell, 1992; Easley et al., 2001; Kryzanowski and Zhang, 1996; Lamoureux and Poon, 1987; Maloney and Mulherin, 1992). Goyenko et al. (2006) and Huang et al. (2015) amongst others however find that splits have little to no effect on liquidity in the long term.

Muscarella and Vetsuypens (1996) address the contradictory findings at the time by observing splits of American Depositary Receipts (ADR). This enabled isolation of the

liquidity effect from the potential explanation of signaling when a firm decides to split the underlying stock. The study finds that there are improvements in liquidity when splitting the ADR and returning it to a more optimal trading range for a post-period of 120 days, indicating that splits are not purely cosmetical. Muscarella and Vetsuypens (1996) attribute the improvement in liquidity to a number of explanations; an existing optimal price range for tick sizes, lower prices facilitating capital-constrained investors to trade in round lots making it easier to diversify, and increased incentives for analyst coverage by the structure of brokerage fees.

2.3.1 Tick Sizes

Tick sizes are by several studies documented to have an impact on stock liquidity under the liquidity hypothesis. The tick size can be affected by a split in two ways: through a relative increase if the tick size is constant, or through a decrease if it is decided upon stock price.

Harris (1994) is one of the pioneers in forming theories about liquidity, particularly in relation to tick sizes, and suggests that the effects of a decreased tick size can be double-edged. During times when a stock's tick size is binding (spread equal to the tick size so that orders in between are not possible), a decreased tick size will most likely result in a decreased bid-ask spread. Moreover, smaller tick sizes allow actors to place orders before others at a smaller cost, which also would result in a decreased spread. Similar results are found by Gerace and Smark (2012), where smaller tick sizes strongly reduce the spread after regulatory changes in Hong Kong.

There are well-documented effects on the depth in orders, where Gerace and Smark (2012) find that a reduced tick size drastically decreases depth in orders. However, they find that the decrease in spreads dominates the decrease in depth in orders, and altogether improves the liquidity. A decrease in depth of orders following a decrease in tick size is further documented by among others Harris (1994), Goldstein and Kavajecz (2000), Niemeyer and Sandås (1995), Aitken and Comerton-Forde (2005), Ahn et al. (2007), Gerace and Smark (2012) and Bacidore (1997). Harris (1994) explains the decrease in depth in orders by the fact that the compensation for providing liquidity decreases. He shows that the larger order one actor is to put, the larger spread the actor requires to compensate for the risk of being exploited by more informed traders. Further, a larger tick size can raise the costs of gaining precedence over limit orders in the order queue, which attracts more limit orders. By the

same logic, a lower tick size decreases the value of the price-and-time order-prioritizing rule, as the risk of getting exploited for revealing information through placing an order increases. This leads to a decrease in orders and thus less depth (Harris, 1994). In line with Harris' argument, Angel (1997) suggests that a larger tick size can reduce bargaining and processing costs, and thus transaction costs, which altogether enhances liquidity. However, the majority of researchers find that a smaller tick size ultimately leads to improved liquidity.

2.3.2 Fees

It is acknowledged that a higher stock price is better suited for high-capital investors if the brokerage fee depends on the number of traded shares since it minimizes trading costs (Brennan and Copeland, 1988; Copeland, 1979). This suggests that a split would result in lower liquidity due to increased trading costs, but Brennan and Hughes (1991) argue that this can be offset by an increase in analyst coverage resulting in a larger ownership base and thus higher trading activity. This is because a lower price increases incentives for analysts to cover the firm in order to maximize brokerage fees (Brennan and Hughes, 1991). Investors only trading stocks they know about would motivate the cost of increased analyst coverage since it would result in increased trading (Kadlec and McConnell, 1994; Merton, 1987). Ultimately, Brennan and Hughes (1991) find that even though transaction costs may increase for existing shareholders, liquidity may be improved in total if a split succeeds in attracting sufficiently many new shareholders.

2.3.3 Lot Sizes

A lower stock price is preferred by capital-constrained investors since it decreases odd-lot brokerage costs and facilitates round-lot trading, easing diversification (Maloney and Mulherin, 1992). The same reasoning applies to the findings by Gompers and Metrick (2001), suggesting that institutional ownership increases with the share price, and to the findings by Kumar and Charles (2006), suggesting that private individuals tend to hold stocks in the lower price range. Lamoureux and Poon (1987) among others find an increased ownership base following a split, which by Benston and Hagerman (1974) is found to decrease the bid-ask spread. It is further argued by Amihud et al. (1999) that decreased lot sizes (minimum investment) leads to a larger number of shareholders, which in turn increases trading volumes and order depths.

3. Methodology

In this section, we first present the hypotheses to be tested in this study. We then describe the chosen variables to represent liquidity, followed by a presentation of the data and the process in which it has been collected. We subsequently present our research design and the tests we run to answer our research question, and lastly discuss the validity, reliability, and limitations of our study.

3.1 Hypotheses

The theoretical background serves as the basis for the questions we intend to test to capture the liquidity effects of the split. All-in-all, previous literature favors the notion that share splits improve liquidity in the short term under the signaling hypothesis, and in the long term under the liquidity hypothesis. Since it is difficult to determine when liquidity has improved due to the complexity of its nature, we formulate the hypotheses on the basis of different metrics. Thus, we formulate six hypotheses to test if liquidity improves both in the short term and in the long term for each chosen liquidity metric:

H1*: The bid-ask spread will decrease in the short-term surrounding the split*
H2*: The bid-ask spread will decrease in the long-term following the split*

H3*: The turnover ratio (trading volume in monetary terms in relation to market capitalization) will increase in the short-term surrounding the split*
H4*: The turnover ratio (trading volume in monetary terms in relation to market capitalization) will increase in the long-term following the split*

H5*: The depth in orders, captured by the Amivest Liquidity Ratio, will increase in the short-term surrounding the split*
H6*: The depth in orders, captured by the Amivest Liquidity Ratio, will increase in the long-term following the split*

3.2 Description of Liquidity Metrics

Stock liquidity is rather complex as it can be defined in different ways. Different metrics capture varying forms of liquidity, of which many provide contrasting results. It is therefore

important to study more than one metric to understand the effects on liquidity as a whole. Three metrics are chosen to represent liquidity for this study, namely:

- The Bid-Ask Spread
- The Turnover Ratio (daily trading volume, in monetary terms, in relation to market capitalization)
- The Amivest Liquidity Ratio (ALR)

3.2.1 Bid-Ask Spread

Amihud and Mendelson (1986) study liquidity in the shape of the bid-ask spreads and defines illiquidity as the cost of immediate execution. When trading an asset, an investor can either place an order and wait for the desired price to be matched or execute the trade immediately at the current bid or ask price. The higher premium required to execute the order immediately, the lower the liquidity of the stock. It is further emphasized that the relative spread is negatively correlated with other characteristics of liquidity, such as trading volume and the number of shareholders. Thus, the bid-ask spread can serve as a good proxy for liquidity, although a decrease in the spread often is associated with a smaller depth in orders.

The daily bid-ask spread is captured by putting the daily closing bid and ask price against the closing share price, and is calculated by:

$$\text{Bid-Ask Spread} = \frac{Ask_{ij} - Bid_{ij}}{Share\ Price_{ij}} \qquad (1)$$

Where Ask_{ij} is the daily closing asking price for trading day *i* for firm *j,* Bid_{ij} is the daily closing bid price for trading day *i* for firm *j*, and Share Price_{ij} is the closing share price for trading day *i* for firm *j*.

3.2.2 Turnover Ratio

The daily trading volume in monetary terms in relation to market capitalization (turnover ratio) captures the liquidity through the volume traded in relation to the firm's size. The trading volume is scaled as it is likely to increase/decrease with market capitalization, mitigating the risk of a trend unrelated to the event when studying a longer time period. Many studies examine trading volume as a metric for liquidity (Huang et al., 2015; Lamoureux and Poon, 1987; Amihud et al., 1999), and we choose to scale it to reduce the risk of trend as previous studies have found that corporate actions might lead to increased liquidity in

absolute terms, but not when putting it in relation to market capitalization (Cooper et al., 1985). A limitation when studying splits and scaling liquidity with market capitalization is that firms often have experienced strong market performance before performing the split which runs the risk of misvaluing the liquidity before the event. A higher market value should however also imply a larger trading volume which mitigates this risk.

The daily turnover ratio is calculated by:

$$\text{Turnover Ratio}_{ij} = \frac{[VOL]_{ij}}{M_{ij}} \qquad (2)$$

Where $[VOL]_{ij}$ is the trading volume in monetary terms on trading day *i* for firm *j* and M_{ij} is the closing market capitalization after trading day *i* for firm *j*.

3.2.3 Amivest Liquidity Ratio

The third liquidity metric to be examined is the Amivest Liquidity Ratio (ALR) which captures the depth in orders. ALR is a widely used metric to capture the order depth and is used in previous studies such as Elyasiani et al. (2000). By dividing the daily trading volume in monetary value by the absolute return for the same day, one can tell how much trading volume is needed to move the share price, which can be used as a proxy for the depth of market orders (ibid). This is a good complement to the bid-ask spread measure since it not only shows if there are buyers and sellers close to each other but also captures the volume of those buyers and sellers, which in turn shows how large orders can be executed without significantly moving the share price. A higher ratio implies greater market depth or liquidity. All days where the share price development is unchanged for a firm are excluded as the ratio is undefined for those days. The values are scaled by the natural logarithm so that the companies with high trading volumes are not overrepresented in the results.

The daily ALR is calculated by:

$$\text{ALR}_{ij} = \frac{[VOL]_{ij}}{|r_{ij}|} \qquad (3)$$

Where $[VOL]_{ij}$ is the daily trading volume in monetary terms for firm *j* on trading day *i*, and $|r_{ij}|$ is the daily percentage stock return in absolute values for firm *j* on trading day *i.*

3.3 Description of Data

3.3.1 Data Collection

Data for splits is gathered from news announcements from Nasdaq Stockholm. From there, the first trading day after the split, as well as the split ratio, is collected manually from the announcements. The data points to be analyzed are retrieved from Refinitiv Eikon. The daily metrics that are retrieved for each active trading day in each respective company's time period are:

- Closing share price
- Stock return in percentage terms
- The closing bid-ask spread
- Trading volume in monetary terms
- Closing market capitalization

3.3.2 Selection of the Study Period

The study is limited to splits that have been performed from January 2013 until February 2022. Many previous studies mentioned in the literature review examine liquidity in relation to stock splits with larger, historical data sets. However, the last decade is interesting to study since it has been characterized by remarkable changes in market conditions (see section 2.1), which can be expected to contribute to reduced liquidity effects from share splits compared to what earlier studies have found.

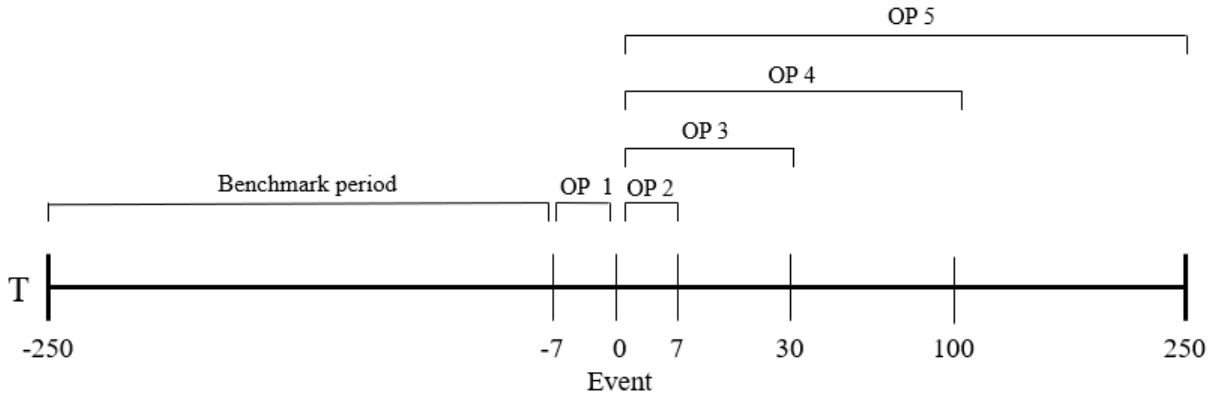
With the intention to capture the effect after the changes in market conditions on the Swedish market, we limit our time frame to include splits conducted after the implementation of MiFID in 2007 and the aforementioned "revolution" in 2009. After reviewing the distribution of splits on Nasdaq over the years since then, we choose to start our time frame from 2013 since there were a very limited number of splits performed after the financial crisis up until that year. We end our time frame with splits performed in February 2022 at the latest to be able to retrieve daily data one year after the event.

In the normal case of an event study, the variable is observed the day before and after the event but has to be adapted to the aims of the study so that all effects are captured (MacKinlay, 1997). It is therefore possible to include an extended time period before and

after the event. To test if the observed events impact both the short-term and long-term liquidity, the liquidity is observed for both long and short periods around the event. We retrieve daily data from 250 days before and after the execution date denoted as T0, as those serve as our longest periods. We split the data into six different time periods as follows:

- Benchmark period
    - T-250 up to and including T-8
- Observation periods
    - 7 days pre: T-7 up to and including T-1
    - 7 days post: T1 up to and including T7
    - 30 days post: T1 up to and including T30
    - 100 days post: T1 up to and including T100
    - 250 days post: T1 up to and including T250

Figure 1. Illustration of the observed time periods



Where OP denotes the different observation periods

The method of measuring 250 trading days was introduced by Elyasiani et al. (2000) as 250 trading days fairly accurately represent a full trading year. Using too long of a time period runs the risk of capturing effects from other company-specific events not related to the split. Therefore, we use a trading year as the longest coverage period since we expect it to capture the long-term liquidity effects without the risk of potential seasonality effects influencing the results. We also include the periods 30 and 100 days after the split to test if there might be liquidity benefits not attributed to signaling, but in shorter observation periods than a year. The period seven days after the split is included to capture any short-term liquidity effects,

and the period seven days before the split is included to capture the signaling effects of the announcement.

We choose not to specify the announcement date of each split as it in many cases is difficult to pinpoint which exact date the market was notified of the company's intention to split its share. The decision is often voted through at the annual general meeting, then announced by the company, and subsequently announced formally by Nasdaq. We therefore choose to test the first seven trading days before the execution date of the split as the announcement in most cases, to the best of our knowledge, is found within that time period in our dataset. We acknowledge that the unspecified announcement date may distort our results as it does not capture the period between the announcement and execution date to the exact day, but we believe that the seven days provide a fairly accurate estimate. By the same reasoning, we exclude these seven days from the benchmark period to capture the level of liquidity before the market becomes aware that the split will be executed.

3.3.3 Selection of the Splitting Firms

After having defined the period of coverage, the selection criteria for the splitting firms have to be decided, which according to MacKinlay (1997) can be which marketplace it is listed on, firm value, or industry. All companies listed on Nasdaq Stockholm that have performed a share split from January 2013 to February 2022 are studied. The reasoning behind only studying Nasdaq Stockholm, and not smaller marketplaces such as First North and Spotlight Stock Market, is due to the significant difference in firm size and liquidity, as well as the small samples to study on the smaller marketplaces. During the 250 trading days before and after the event, the firm may not have performed another split as it could affect the liquidity. For firms that have actively traded A and B shares, where both have been split simultaneously, the one with the highest trading volume before the split is studied. Lastly, splitting firms with insufficient data points are not included in the dataset, leaving us with 64 events to study.

Table 1. Yearly and monthly distribution of the share splits

Month	#
January	5
February	0
March	0
April	7
May	27
June	14
July	0
August	0
September	2
October	3
November	1
December	5

Year	#
2022	2
2021	16
2020	4
2019	6
2018	10
2017	7
2016	5
2015	9
2014	4
2013	1

Most splits are executed in April-June as firms usually take the decision at the annual general meeting and execute the split shortly thereafter. Some years are more represented than others in the data, but we will be able to identify if this drives any of the results after conducting all tests specified in 3.4.

Table 2. Distribution of split ratios

Split ratio	#
2:1	17
3:1	15
4:1	14
5:1	8
6:1	2
7:1	1
8:1	1
9:1	0
10:1	6

Smaller split ratios constitute the majority of the studied splits, with over 70% consisting of 2:1, 3:1, or 4:1 ratios. Six out of the 64 studied splits were made with a larger split ratio of 10:1.

3.3.4 Selection of the Control Firms

The control firms, i.e. the companies that have not performed a split, consist of companies matched on similar characteristics to the splitting firms. The control firms are matched by using a similar process as Huang et al. (2015), where each of the observed companies is matched with a similar control firm in terms of liquidity. The control firms are chosen on characteristics such that they should be the ones with the closest motives to perform a split as they are in the same price range, but choose not to do so. They are not chosen to be similar to the splitting firms on any other characteristics than liquidity, such as industry, as we want to minimize possible information spillover effects from the announcement and execution of the split.

We match each company on three criteria:

1. The firm should be listed on Nasdaq Stockholm.
2. The firm should have an average trading volume in monetary terms of +/- 10% of the splitting company during the benchmark period, excluding the seven trading days before the split.
3. Of the companies that satisfy the two criteria above, we choose the one with the closest price per share to the observed company the day before the split.

After the process of matching the companies, we obtain the same data as for the splitting firms during the corresponding time periods. No control firm that has performed a split within the approximate two years of the event period is chosen, as the intention of this study is to compare the splitting firms to similar firms that have chosen not to.

3.4 Research Design

The study will be executed using an event study, which is a common method used in accounting and finance research when observing how a specific event affects the value of a company (MacKinlay, 1997). In this study, the execution of share splits will constitute the events, and instead of observing the effect on the value of the company, the effect on liquidity will be observed.

Similar to Huang et al. (2015), we use two different Student's t-tests to examine the effect of the splits, one only testing the effect on the splitting firms, and one where we test the effect in relation to control firms. We then add a third test to examine individual firm effects to identify if the results from the first two tests are driven by specific companies and to see if these share any similar characteristics.

3.4.1 Test I

In the first test we run, the effect on the splitting firms is tested by comparing the benchmark period with the different observation periods. We compare the benchmark period with five different observation periods, specified in 3.3.2. The difference in the average for each liquidity metric is calculated for each individual company and time period, constituting the sample for the t-test. Three liquidity metrics and five different observation periods are tested for a total of 15 t-tests. One-sample t-tests are run to test whether the mean of the change across the splitting firms is statistically different from zero.

After reviewing the statistical procedure to perform the t-tests, we must make a number of assumptions (Newbold et al., 2013). First, we assume that the values in the sample are independent of each other as they are retrieved from unique time periods and firms. The values are continuous and represent all splits under the specified criteria for the test period, meaning there is no risk of selection bias. The last assumption necessary to run the test is the normality of the data. Since we have a large sample (N=64), we assume the data to be normally distributed under the Central Limit Theorem (Newbold et al., 2013). Despite our data being approximately symmetrical, there might not be perfect normality due to outliers. However, as the outliers are part of the data that represents the study period, and not errors in the data selection, we will keep them in the tests in line with the traditional statistical procedure (Newbold et al., 2013). This may affect the statistical validation of the test, but removing them would distort the true effect of the events we wish to study.

The test for each liquidity metric looks as follows:

$$t = \frac{\bar{x}_{ij} - \mu}{\frac{s_{ij}}{\sqrt{N}}} \quad (3)$$

Where $\bar{x}_{ij}$ is the mean of the difference between the benchmark period and period *i* for liquidity metric *j*, μ is the hypothesized population mean (zero), $s_{ij}$is the standard deviation of the difference between the benchmark period and period *i* for liquidity metric *j,* and *N* is the sample size.

3.4.2 Test II

The second test we run is also a one-sample t-test, but with the extension that the values from the first test are adjusted with the change in liquidity for a matched control firm. Our model aims to capture the difference in outcomes (the average liquidity measures) for the splitting firms in the observation- and benchmark periods, to the difference in outcomes for the control firms in the observation- and benchmark periods. Subtracting the difference for control firms is a relatively simple and effective way to isolate the effects of an event by studying the benchmark period and observation periods, and similar methods are used in the context of liquidity in previous literature, such as Huang et al. (2015).

We match every individual company that has performed a split with another firm based on characteristics in the benchmark period to find firms with a similar rationale to split its share given its liquidity and share price (see section 3.3.4). We calculate each individual control firm's change in the three liquidity metrics from the benchmark period to the five later periods. The adjusted change is then calculated by subtracting the change in the matched control firm from the change in the observation firm for each liquidity metric and time period. The strength of the method is that it is possible to compare the observation firm to similar companies that are assumed to have behaved similarly if the event did not happen (Huang et al., 2015). To be able to assume this, we visually observe that the control firms' different aggregated liquidity metrics have behaved similarly to the splitting firms during the benchmark period (see Appendix A). Further, by comparing the differences between the averages we avoid much of the risk of trends unrelated to the split in the liquidity metrics we have in the first test, as the control firms can be expected to follow the same trend if there is any.

We make the same assumptions for independence, continuity, and normality as in the first test, with similar reasoning. The adjusted changes subsequently form the sample for the next t-tests which are run in the same manner as in Equation 3. The calculation for each firm and liquidity metric looks as follows:

$$Adjusted\ change_i = \left(y^{Obs_i} - y^{Bench}\right)^{F_i} - \left(y^{Obs_i} - y^{Bench}\right)^{C_i} \quad (4)$$

Where y^{Obs_i} is the average liquidity metric for observation period *j*, y^{Bench} is the average liquidity metric for the benchmark period, F_i denotes observation firm *i,* and C_i denotes control firm *i*.

3.4.3 Test III

Ultimately, we conduct one Welch's two-sample t-test for each liquidity metric and firm to test the null hypothesis that their means are equal, where the benchmark period and the longest observation period, 250 days, constitute the two samples. By doing this we can see if any firms show significantly larger differences between the benchmark period and the observed periods, driving the results in the previous tests, and then evaluate if these have any specific characteristics that stand out. We further add to the robustness of the previous tests as we do not need to assume normality across the firm mean changes. We only study the longest observation period as the sample sizes, in that case, are very similar, which will provide more robust discussions of the results of the test.

To run the tests, we need to make the assumptions for a two-sample t-test with independent samples and unknown variances (Newbold et al., 2013). We assume that the daily values in the benchmark- and observation period are independent for each liquidity metric and firm, as we do not expect outcomes in one of the periods to affect the chances of outcomes in the other. We also assume that the values follow a normal distribution under the Central Limit Theorem as there are a large number of observations in each sample (N=243 in the benchmark period and N=250 in the observation period). The values are continuous and represent all days under the specified time frame around the split, meaning there is no risk of selection bias. We do not need to assume equal variance as we use Welch's t-test instead of the traditional two-sample Student's t-test. Welch's t-test is expected to give similar results if the variances are close to equal, but provides more robust results if the assumption does not hold (Delacre et al., 2017). Since we run a large number of tests, there is a risk of unequal variances between the periods for some firms, which is why Welch's t-test is used.

Welch's t-test for each liquidity metric and firm is calculated as follows:

$$t = (m_b - m_o) / \sqrt{\frac{S_b^2}{n_b} + \frac{S_o^2}{n_o}} \quad (5)$$

Where m_b and m_o are the means in the benchmark and observation periods respectively, S_b^2 and S_o^2 are the standard deviations in the benchmark and observation periods respectively, and n_b and n_o are the sample sizes of the benchmark and observation period respectively.

The degrees of freedom for the test are estimated as follows:

$$df = (\frac{S_b^2}{n_b} + \frac{S_o^2}{n_o})^2 / (\frac{S_b^4}{n_b^2(n_b-1)} + \frac{S_o^4}{n_o^2(n_o-1)} \quad (6)$$

Where S_b^2 and S_o^2 are the standard deviations in the benchmark and observation periods respectively, and n_b and n_o are the sample sizes of the benchmark and observation period respectively.

3.5 Validity & Reliability

The chosen research method is used in similar ways in previous research, studying the same research question, implying that the validity of the results should be relatively high. One weakness of event studies is however that it is difficult to pinpoint how much of the results can be attributed to the actual event, and what is the result of other corporate events (MacKinlay, 1997). In terms of reliability, the sample and data points have been collected objectively under specified criteria, leaving little room for subjective interpretations from the researchers. This means that a similar study should be able to replicate our method and provide similar results.

3.6 Limitations

One limitation concerns the size of the events in our sample (N=64). The sample sizes of earlier studies vary significantly from as small as two to as big as several thousand. It could be argued that a sample of 64 events is not large enough to draw general conclusions about the liquidity effects of share splits, but the strength is that the sample represents all splits under the selected criteria during the specified time frame.

The selection of the control firms could also be seen as a limitation as it is impossible to match firms perfectly, but a method similar to previously used ones has been adopted to

capture the effects as accurately as possible. Furthermore, the liquidity on the aggregated level looks similar beforehand, as presented in Appendix A, which increases the chance of isolating the effect of the split in an accurate matter.

4. Results

Our results are presented in three sections. In the first section, we provide descriptive statistics on the tested variables. In the second section, the results for the three different t-tests are presented. Lastly in the third section, we display a summary of the results.

4.1 Descriptive Statistics

Tables 3 to 6 present summary statistics for the splitting firms as well as the control firms. The benchmark period is 250 days before the split, excluding the seven days before the split, and the observation period is 250 days after the split. The statistics help us interpret the potential effect of splits on liquidity, which we will test in upcoming sections.

Table 3. Descriptive statistics for the observation group in the benchmark period

Statistic	N	Mean	St. Dev.	Min	Max
Turnover %	15,488	0.16	0.29	0.0000	9.55
Bid-Ask %	15,488	0.49	0.59	0.01	12.75
ALR (000s)	14,640	133,225	747,378	0.80	28,585,264

Table 4. Descriptive statistics for the observation group in the observation period

Statistic	N	Mean	St. Dev.	Min	Max
Turnover %	16,064	0.14	0.24	0.0000	12.06
Bid-Ask %	16,064	0.45	0.50	0.01	8.78
ALR (000s)	15,394	130,050	673,627	0.19	21,044,595

Table 5. Descriptive statistics for the control group in the benchmark period

Statistic	N	Mean	St. Dev.	Min	Max
Turnover %	15,488	0.17	0.30	0.0002	10.91
Bid-Ask %	15,488	0.46	0.52	0.02	7.80
ALR (000s)	14,574	133,040	687,287	3.83	25,874,842

Table 6. Descriptive statistics for the control group in the observation period

Statistic	N	Mean	St. Dev.	Min	Max
Turnover %	16,064	0.18	0.85	0.0000	100.48
Bid-Ask %	16,064	0.42	0.51	0.02	11.75
ALR (000s)	15,272	138,999	739,640	0.15	47,616,562

The summary statistics for the two groups look similar on all liquidity metrics in the benchmark periods. The control firms have a slightly higher turnover ratio at 0.17% during the benchmark period, compared to the splitting firms' 0.16%. The bid-ask spread is marginally higher for the splitting firms during the benchmark period at 0.49%, compared to the control firms' 0.46%. The Amivest Liquidity Ratio naturally varies in size from firm to firm, which is why the values are logarithmically scaled before being tested so the larger firms do not represent most of the data.

The mean spread decreases in the observation period by 0.04 percentage points (pp.) for both groups. The mean turnover ratio increases by 0.01 pp. for the control firms but decreases by 0.02 pp. for the splitting firms. Similarly, the ALR, without taking logarithmic weighting into account, decreases in the observation period for the splitting firms but increases for the control firms. The standard deviation is high for all liquidity metrics as trading volume, spreads, and order depths, vary significantly from day to day and between firms. The standard deviation for all metrics decreases for the splitting firms, although not by much, which is not the case for the control group. This may however be explained by the high maximum values in the observation period for the control group.

The sample size is smaller for the benchmark period as the seven trading days before the split are excluded. The sample for the ALR is also smaller as days with zero returns render the ratio undefined.

4.2 Test Results

4.2.1 Results of Test I

Table 7. T-tests on the change between the benchmark period and the observation periods for the splitting firms

Bid-Ask Spread %	Estimate	Statistic	P-value	Significance
Pre-level	0.488			
7 days before	-0.080	-3.680	0.000	***
7 days after	0.027	0.822	0.414	
30 days after	0.012	0.511	0.611	
100 days after	-0.025	-1.027	0.309	
250 days after	-0.034	-1.338	0.186	

Turnover Ratio %	Estimate	Statistic	P-value	Significance
Pre-level	0.155			
7 days before	0.005	0.400	0.691	
7 days after	0.006	0.481	0.632	
30 days after	-0.007	-0.605	0.547	
100 days after	-0.019	-2.111	0.039	*
250 days after	-0.011	-1.493	0.140	

Log (ALR)	Estimate	Statistic	P-value	Significance
Pre-level	15.959			
7 days before	-0.015	-0.172	0.864	
7 days after	0.014	0.133	0.894	
30 days after	0.183	1.796	0.077	
100 days after	0.142	1.733	0.088	
250 days after	0.243	3.039	0.003	**

Note: The table provides the benchmark period means, and the mean of the changes from the benchmark period to the different observation periods, for the liquidity metrics bid-ask Spread, Turnover Ratio, and the Amivest Liquidity Ratio as a proxy for order depth. ***, **, and * display the significance levels at 0.1%, 1%, and 5% respectively.

Observing the bid-ask spread in percentage terms, the only period where the mean change can be concluded to be different from zero is seven days before the split is executed. The result is significant at the 0.1% significance level with an estimate of -0.08 pp., meaning that the spread decreases the week before the split. The mean changes for the remaining time periods are varyingly positive and negative with small estimates, but all show insignificant results. We can thus not find support for any significant effect on the spread after a split in the longer term.

The change in the turnover ratio only provides significant results in the period 100 days after the split with a negative mean change of 0.019 pp. The results are significant at the 5% significance level, but it should be noted that the significance may be attributed to seasonality. The 100-day observation period in most cases includes the summer, where volumes tend to be lower since splits most often are executed around May/June (see table 1) after being announced at the annual general meeting. If this were to be the case, the seasonality will be dealt with in the second test when subtracting each control firm's change for the same time period. The week before and after the split show positive mean changes but insignificant results, whilst the longer periods show negative mean changes and insignificant results. We can thus not draw any conclusions that share splits have any effect on the daily turnover.

The Amivest Liquidity Ratio as a proxy for depth in orders significantly increases at the 1% level in the longest time period, 250 days after the split, implying an improved depth in order in the longer term. The shorter periods show highly insignificant results, but the 30- and 100-days observation periods show positive mean changes which would be significant at the 10% level. The increase in order depth could have its explanation in a positive long-term trend as trading volume generally increases with time as firms grow. If that is the case, it will be dealt with in the next test when adjusting for the control firms' changes.

4.2.2 Results of Test II

Table 8. T-tests on the adjusted changes

Bid-Ask Spread %	Estimate	Statistic	P-value	Significance
Pre-level	0.488			
7 days before	-0.039	-1.027	0.308	
7 days after	0.057	1.376	0.174	
30 days after	0.018	0.574	0.568	
100 days after	-0.009	-0.225	0.823	
250 days after	0.001	0.028	0.978	

Turnover Ratio %	Estimate	Statistic	P-value	Significance
Pre-level	0.155			
7 days before	-0.008	-0.557	0.579	
7 days after	0.011	0.754	0.454	
30 days after	0.003	0.286	0.775	
100 days after	-0.002	-0.276	0.784	
250 days after	-0.023	-1.357	0.180	

Log (ALR)	Estimate	Statistic	P-value	Significance
Pre-level	15.959			
7 days before	-0.205	-2.380	0.020	*
7 days after	0.092	0.962	0.340	
30 days after	0.086	0.806	0.423	
100 days after	0.171	1.543	0.128	
250 days after	0.070	0.717	0.476	

Note: The table provides the benchmark period means for the splitting firms, and the mean of the changes from the benchmark period to the different observation periods after subtracting the mean change from the benchmark period to the different observation periods for each control firm, for the liquidity metrics bid-ask Spread, daily turnover in monetary terms to market capitalization, and the Amivest Liquidity Ratio as a proxy for order depth. ***, **, and * display the significance levels at 0.1%, 1%, and 5% respectively.

After subtracting the mean change from the control firms for each individual observation firm, we are only left with one significant result out of all the liquidity metrics and observation periods. The Amivest Liquidity Ratio significantly decreases during the week before the execution date at the 5% significance level, implying that the depth in orders is lower the week before the split.

The bid-ask spread no longer decreases significantly the week before the split. The turnover ratio is insignificant after subtracting the change in the control firms, indicating that the seasonality had explanatory power in the first test. The ALR is not significantly positive in the longer time periods in this test either, suggesting that the positive trend from growing firms could help explain the results from the earlier t-test.

4.2.3 Results of Test III

Table 9. Firms with the highest mean differences in bid-ask spread between the benchmark period and observation period of 250 days

Firm	Mean pp. Diff in Bid-Ask Spread	P-value	Split Ratio	Market Capitalization (MSEK)	Split Year
Median	**0.001**		**3.5:1**	**13,053**	
Firm 55	-0,845***	6.7843e-11	3:1	3,983	2014
Firm 35	-0,609***	1.9129e-18	4:1	5,466	2017
Firm 45	-0,470***	2.3348e-10	2:1	672	2016
Firm 54	-0,411***	1.1139e-13	4:1	9,257	2020
Firm 18	-0,330***	1.3309e-10	4:1	7,434	2021
Firm 29	-0,248***	2.3880e-05	3:1	5,743	2016
Firm 24	-0,247***	1.4620e-09	10:1	14,994	2021
Firm 48	-0,231***	1.0767e-13	3:1	15,120	2018
Firm 26	-0,209***	2.3328e-21	3:1	11,794	2020
Firm 40	-0,185***	4.2797e-06	3:1	14,842	2017

Note: The table provides the firms with the ten highest decreases in bid-ask Spread between the observation period of 250 days and the benchmark period, and the corresponding mean differences, p-values for the t-tests, split ratio, market capitalization the day before the execution date, and the year of the split. The highest decreases are provided to capture the positive liquidity effect. The median values for the sample for the ones concerned are provided for reference. ***, **, and * display the significance levels at 0.1%, 1%, and 5% respectively.

Table 10. Firms with the highest mean differences in the turnover ratio between the benchmark period and observation period of 250 days

Firm	Mean pp. Diff in Turnover	P-value	Split Ratio	Market Capitalization (MSEK)	Split Year
Median	**-0.005**		**3.5:1**	**13,053**	
Firm 46	0,208***	1.3326e-18	2:1	8,815	2017
Firm 48	0,102***	1.0439e-13	3:1	15,120	2018
Firm 6	0,062*	0.0158	8:1	24,853	2015
Firm 63	0,062***	1.5584e-04	4:1	24,555	2015
Firm 54	0,054	0.0761	4:1	9,257	2020
Firm 35	0,042***	1.4290e-06	4:1	5,466	2017
Firm 43	0,036***	7.2409e-05	10:1	8,404	2021
Firm 37	0,034*	0.0250	2:1	5,630	2019
Firm 24	0,034	0.0549	10:1	14,994	2021
Firm 60	0,034**	0.0011	10:1	29,254	2015

Note: The table provides the firms with the ten highest increases in turnover in relation to market capitalization between the observation period of 250 days and the benchmark period, and the corresponding differences, p-values for the t-tests, split ratio, market capitalization the day before the execution date, and the year of the split. The highest increases are provided to capture the positive liquidity effect. The median values for the sample for the ones concerned are provided for reference. ***, **, and * display the significance levels at 0.1%, 1%, and 5% respectively.

Table 11. Firms with the highest mean differences in the natural logarithm of the Amivest Liquidity Ratio between the benchmark period and observation period of 250 days

Firm	Mean Diff in log(ALR)	P-value	Split Ratio	Market Capitalization (MSEK)	Split year
Median	**0.135**		**3.5:1**	**13,053**	
Firm 48	2,405***	3.5401e-58	3:1	15,120	2018
Firm 35	1,527***	8.6041e-35	4:1	5,466	2017
Firm 54	1,394***	5.2268e-28	4:1	9,257	2020
Firm 55	1,302***	5.0066e-18	3:1	3,983	2014
Firm 18	1,213***	5.3709e-19	4:1	7,434	2021
Firm 45	1,117***	2.0871e-30	2:1	672	2016
Firm 29	0,972***	2.1682e-14	3:1	5,743	2016
Firm 43	0,744***	1.3875e-15	10:1	8,404	2021
Firm 26	0,713***	4.2503e-12	3:1	11,794	2020
Firm 31	0,694***	1.7138e-15	2:1	5,137	2016

Note: The table provides the firms with the ten highest increases in the natural logarithm of the Amivest Liquidity Ratio between the observation period of 250 days and the benchmark period, and the corresponding differences, p-values for the t-tests, split ratio, market capitalization the day before the execution date, and the year of the split. The highest increases are provided to capture the positive liquidity effect. The median values for the sample for the ones concerned are provided for reference. ***, **, and * display the significance levels at 0.1%, 1%, and 5% respectively.

Most mean changes amongst the top 10 firms are significant at the 0.1% significance level. No particular year in which the split was executed seems to be overrepresented in the results, implying that they are not driven by trends in any particular time period.

The largest decreases in the bid-ask spread generally stem from small firms, which could be explained by strong share price development and higher trading volumes, leading to lower tick sizes, and in turn a reduced spread. The share of liquidity improvements attributed to growth is partly mitigated by subtracting the change in the control firms, but not entirely as they cannot be expected to have followed the exact same trend.

The firms with the highest positive changes in the turnover ratio are generally larger compared to the top ten improvements in the other liquidity metrics. This was rather expected as the ratio takes the share price development into account, and thus scales smaller firms that experience strong market performance with a higher base. These firms are also characterized by larger split ratios in general with half of the 10:1 splits being found in the top ten.

The firms with the highest change in the ALR are generally small, as nine out of ten are smaller than the median of the sample. This could be expected as smaller firms have the potential to grow trading volumes faster than larger firms. The smaller firms thus contribute more to the positive long-term trend that was discussed in relation to our first test and explain the significant positive result in the 250-day observation period. Since we match the control firms based on similar liquidity metrics in the benchmark period, the positive trend is subtracted from another small firm that is more likely to experience a similar trend, driving the insignificant results in the second test. The same line of reasoning applies to the insignificance of the bid-ask spread.

4.3 Summary of Results

Table 12. Results in relation to the hypotheses

Liquidity Metric	Long-term	Short-term
Bid-Ask Spread	0	-
Turnover Ratio	0	0
Amivest Liquidity Ratio	0	-

Note: 0 denotes insignificant results, and – denotes significantly decreasing results.

5. Discussion

The decrease in bid-ask spreads seven days before the split for the splitting firms, and the insignificant but still negative estimate in the second test goes in line with the signaling hypothesis. This suggests that a split comes with new information, reducing information asymmetry and resulting in less compensation required for placing an order in the form of spread, as suggested by, among others Fama et al. (1969), Brennan and Copeland (1988) and McNichols and Dravid (1990). The insignificant and smaller estimate in the second test is due to the control firms' generally improved spread during the same period. This could potentially be explained by the fact that splits are typically executed during times of other corporate events such as annual general meetings and quarterly reports, contributing to decreased information asymmetry for the control firms as well. Since the estimate is small in the first test, the results are no longer significant in the second, indicating that there is no substantial effect of the split.

The insignificant results in the other periods, which are meant to evaluate the liquidity hypothesis, speak against the literature arguing for improved long-term liquidity following splits (Lamoureux and Poon, 1987; Baker and Powell, 1992; Muscarella and Vetsuypens, 1996). The microstructural effects found in earlier research by Harris (1994) studying tick sizes, Brennan and Hughes (1991) studying effects on the ownership base in relation to brokerage fees, and Maloney and Mulherin (1992) studying the relationship between ownership base lot sizes, are absent in our results. This can be explained by the studied time frame, as market conditions are significantly different now compared to the 1900s and early 2000s. For example, the tick sizes relative to nominal prices were generally at higher levels before, and the tick size reductions studied by Harris (1994) and Gerace and Smark (2012) were larger than the reductions following splits under the MiFID regulation studied in this paper. This used to motivate the documented decrease in bid-ask spreads following tick-size reductions, but the effect seems to be limited today due to the smaller relative change following the split. The insignificant results can further be explained by the absence of lot sizes, and that brokerage fees are no longer based on the number of shares on the Swedish market. Splits under the existence of lot sizes could make the stock attractive to more investors (Maloney and Mulherin, 1992), and brokerage fees based on the number of shares traded could increase the shareholder base due to increased analyst coverage (Brennan and Hughes, 1991). A larger shareholder base could, according to Benston and Hagerman (1974), decrease the bid-ask spread. However, these liquidity benefits are not demonstrated in our results, likely due to the changed market conditions.

The insignificant results in the tests for the turnover ratio, after taking the seasonality explanation into account, can once again be explained by the development of the structure of the market. Brennan and Hughes' (1991) argument that a lower stock price leads to increased incentives for analysts to cover the firm, and in turn to higher trading volumes, has diminished in relevance due to the absence of brokerage fees based on the number of traded shares. The insignificant results can, similar to the reasoning for the bid-ask spread, also be explained by the absence of lot sizes, as Amihud et al. (1999) argue that a lower minimum investment increases trading volumes.

It is interesting to note that the splits with higher split ratios are overrepresented amongst the firms with the largest increases in the turnover ratio. This suggests that there may be liquidity effects associated with a split when there is a larger change in share price, but that the effects

from splits with smaller ratios are limited enough to not make any major difference in general. These results suggest that most splits are cosmetic, but the overrepresentation of 10:1 splits amongst the most improved firms in terms of turnover suggests that they might be necessary when the price has become excessively high. This would imply that there still is some form of an optimal trading range, but that the changes in market conditions have made it wide enough so that splits with small ratios are less critical to maintain maximized liquidity, as was the intention with the development of MiFID. Share splits are, under that notion, still necessary to maximize liquidity over time, but most of the splits performed today are too small to have any significance.

The decrease in order depth in the seven days before the split, captured by the ALR, suggests that there is an effect connected to the decrease in bid-ask spreads. This is in line with Harris' (1994) argument that the larger order one actor is to put, the larger spread is demanded to compensate for the risk of getting exploited by more informed traders. The argument holds even though the effect is not observed in the later time periods since the decrease in bid-ask spreads can be temporary following the signaling effect. It should be noted that the magnitude of the change is small despite its significance, meaning that the economic relevance should be limited.

In the longer time periods, we see no effect in the second test as the trend is removed through the control firms, mitigating the effect caused by firms growing over time. The ALR is from the historical literature expected to show liquidity effects on the contrary from the bid-ask spread (Ahn et al. 2007; Aitken and Comerton-Forde, 2005; Bacidore, 1997; Gerace and Smark, 2012; Goldstein and Kavajecz, 2000; Harris, 1994; Niemeyer and Sandås, 1995). As we see no effect in the long term for the spread, we see no reductions in the ALR due to similar explanations, suggesting that the market conditions in our time frame decrease the magnitude of long-term liquidity effects following splits. The tick size, for instance, not only impacts the bid-ask spread but also the depth in orders through the price-and-time order-prioritizing rule, as suggested by Harris (1994). As splits' effect on tick sizes is limited under the studied market conditions, the cost of placing an order before the queue is not reduced by much, implying that investors have the same incentives to place orders as before the split. Further, the argument by Amihud et al. (1999), concerning decreased lot sizes (minimum investment) leading to more shareholders and increased order depth is not of relevance today

due to the absence of lot sizes. Altogether, this likely contributes to the insignificant effect on ALR in the long term.

Lastly, an interesting observation is that the standard deviation decreases for the observation firms in the period of 250 days after the split, which is not the case for the control firms. This suggests that splits result in less volatile liquidity, which also can be interpreted as an improvement as the trading environment for investors becomes more predictable. Thus, it should be emphasized that the concept of liquidity is complex and that splits might have effects on other metrics outside the scope of this study.

6. Conclusion

The purpose of this study has been to examine stock splits' effects on liquidity under modern market conditions in the Swedish setting. In general, we find little support that splits have had any significant effects on liquidity from 2013 to 2022. We find some support in line with the signaling hypothesis as the liquidity seems to temporarily improve during the seven days before the split through a smaller bid-ask spread, which by Fama et al. (1969) is suggested to be an effect of decreased information asymmetry. This positive effect is however mitigated through the decrease in depth in orders so that the overall liquidity improvement can be considered limited. We find no support for the liquidity hypothesis as we get insignificant results on all metrics and observation periods following the split, suggesting that the changes in market conditions have diminished splits' long-term effect on liquidity to a point where it can no longer be observed on a general level.

Moreover, our results show that i) the bid-ask spread decreases during the seven days before the split, but the positive liquidity effect is mitigated by a decrease in the order depth, ii) the turnover in relation to market capitalization is most affected if the split ratio is large but not in general following a split and iii) the Amivest Liquidity Ratio shows no evidence for increased liquidity in the long term as the most affected firms are small and the improvement can be attributed to other factors.

There are two main practical implications of our findings. Firstly, they can provide insights for decision-makers in understanding that splits today might not have the same liquidity effects as they have had in the past. Secondly, they can help investors understand that a

positive share price reaction following the announcement of a split should generally not be justified by an expected increase in liquidity for firms on Nasdaq Stockholm.

Although we find no long-term liquidity benefits from share splits on the Swedish market, we do not claim them to be non-necessities. Liquidity benefits may not justify the execution of splits on a general level, although the existence of an optimal trading range suggests that firms over time still must split their shares to maintain a maximized level of liquidity. Our findings however suggest that the market conditions in which Swedish firms operate today have stretched that range far enough to make the required frequency of splits significantly smaller.

7. Future Research

After conducting the study and analyzing our results, we acknowledge several opportunities for future research within the area. Firstly, researchers could look further into the effect of splits with different split ratios to nuance the discussion concerning the size of the optimal trading range. By doing so, one could identify a more specific trading range in which splits might have an effect and determine a theoretical "roof" for the nominal share price to still maximize liquidity.

Secondly, the standard deviation of the liquidity metrics could be interesting to study further, as we have seen little discussion around it in the existing literature. As we identified lower volatility in the metrics for the splitting firms which implies higher predictability, this could be incorporated into the discussions of future literature on the subject to add to the complex nature of liquidity. If lower volatility in the traditional liquidity metrics is found to be significant after conducting a split, that could provide a reason for the execution even when improved liquidity measured by common methods do not.

Lastly, future research could consider studying different marketplaces to gain a better understanding of which types of firms may be affected by a split. The firms on Nasdaq Stockholm are relatively liquid, so studying marketplaces with less liquid shares such as First North or Spotlight Stock Market might provide different insights.

8. References

Books:

Newbold, P., Carlson, W.L and Thorne, B.M. Statistics for Business and Economics. 8th Edition, Pearson., 2013 pp. 284-327 and pp. 385-416

Academic Journals:

Ahn, H., Cai, J., Chan, K. and Hamao, Y., 2007. Tick size change and liquidity provision on the Tokyo Stock Exchange. *Journal of the Japanese and International Economies,* 21(2), pp. 173-194.

Aitken, M. and Comerton-Forde, C., 2005. Do reductions in tick sizes influence liquidity? *Accounting & Finance,* 45(2), pp. 171-184.

Amihud, Y. and Mendelson, H., 1986. Asset pricing and the bid-ask spread. *Journal of Financial Economics,* 17(2), pp. 223-249.

Amihud, Y., Mendelson, H. and Uno, J., 1999. Number of Shareholders and Stock Prices: Evidence from Japan. *The Journal of Finance,* 54(3), pp. 1169-1184.

Angel, J.J., 1997. Tick Size, Share Prices, and Stock Splits. *The Journal of Finance,* 52(2), pp. 655-681.

Anshuman, V.R. and Kalay, A., 2002. Can splits create market liquidity? Theory and evidence. *Journal of Financial Markets,* **5**(1), pp. 83-125.

Bacidore, J.M., 1997. The Impact of Decimalization on Market Quality: An Empirical Investigation of the Toronto Stock Exchange. *Journal of Financial Intermediation,* 6(2), pp. 92-120.

Baker, H.K. and Gallagher, P.L., 1980. Management's View of Stock Splits. *Financial Management,* **9**(2), pp. 73-77.

Baker, H.K. and Powell, G.E., 1992. Why Companies Issue Stock Splits. *Financial Management,* 21(2), pp. 11.

Benston, G.J. and Hagerman, R.L., 1974. Determinants of bid-asked spreads in the over-the-counter market. *Journal of Financial Economics,* 1(4), pp. 353-364.

Brennan, M.J. and Copeland, T.E., 1988. Stock splits, stock prices, and transaction costs. *Journal of Financial Economics,* 22(1), pp. 83-101.

Brennan, M.J. and Hughes, P.J., 1991. Stock Prices and the Supply of Information. *Journal of Finance (Wiley-Blackwell),* 46(5), pp. 1665-1691.

Brennan, M.J. and Subrahmanyam, A., 1995. Investment analysis and price formation in securities markets. *Journal of Financial Economics,* **38**(3), pp. 361-381.

Chakraborty, A., Grant, J. L., Trahan, E. A., and Varma, B. (2020). Seeking alpha from stock splits. *Journal of Investing, 29*(4), 77-91.

Conrad, J.S. and Conroy, R., 1994. Market Microstructure and the Ex-Date Return. *The Journal of Finance,* 49(4), pp. 1507-1519.

Copeland, T.E., 1979. Liquidity Changes Following Stock Splits. *The Journal of Finance,* 34(1), pp. 115-141.

Delacre, M., Lakens, D. and Leys, C., 2017. Why Psychologists Should by Default Use Welch's t-test Instead of Student's t-test. *International Review of Social Psychology*, 30(1), p.92-101

Easley, D., O'hara, M. and Saar, G., 2001. How Stock Splits Affect Trading: A Microstructure Approach. *The Journal of Financial and Quantitative Analysis,* 36(1), pp. 25-51.

Elyasiani, E., Hauser, S. and Lauterbach, B., 2000. Market Response to Liquidity Improvements: Evidence from Exchange Listings. *Financial Review,* 35(1), pp. 1.

Fama, E.F., 1970. Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance,* 25(2), pp. 383-417.

Fama, E.F., Fisher, L., Jensen, M.C. and Roll, R., 1969. The Adjustment of Stock Prices to New Information. *International Economic Review,* 10(1), pp. 1-21.

Gerace, D. and Smark, C., 2012. Impact of Reduced Tick Sizes on the Hong Kong Stock Exchange. *Journal of New Business Ideas & Trends,* 10(2), pp. 54-71.

Goldstein, M.A. and A. Kavajecz, K., 2000. Eighths, sixteenths, and market depth: changes in tick size and liquidity provision on the NYSE. *Journal of Financial Economics,* 56(1), pp. 125-149.

Gompers, P.A. and Metrick, A., 2001. Institutional Investors and Equity Prices. *The Quarterly Journal of Economics,* 116(1), pp. 229-259.

Cooper, S.K., Groth J.C. and Avera, W.E., 1985. Liquidity, exchange listing, and common stock performance. *Journal of Economics and Business*, Volume 37, Issue 1, pp. 19-33,

Goyenko, R., Holden, C. and Ukhov, A., 2006. Do Stock Splits Improve Liquidity?. *Working paper, Indiana University*

Grinblatt, M.S., Masulis, R.W. and Titman, S., 1984. The valuation effects of stock splits and stock dividends. *Journal of Financial Economics,* 13(4), pp. 461-490.

Gupta, A., and Arya, P. K. (2020). Impact of splits on stock splits ratios around announcement day: Empirical evidence from india. *Investment Management & Financial Innovations, 17*(3), 345-359.

Harris, L.E., 1994. Minimum Price Variations, Discrete Bid--Ask Spreads, and Quotation Sizes. *The Review of Financial Studies,* 7(1), pp. 149-178.

Huang, G., Liano, K. and Pan, M., 2015. The effects of stock splits on stock liquidity. *Journal of Economics & Finance,* 39(1), pp. 119-135.

Ikenberry, D.L. and Ramnath, S., 2002. Underreaction to Self-Selected News Events: The Case of Stock Splits. *The Review of Financial Studies,* 15(2), pp. 489-526.

Kadlec, G.B. and Mcconnell, J.J., 1994. The Effect of Market Segmentation and Illiquidity on Asset Prices: Evidence from Exchange Listings. *The Journal of Finance,* 49(2), pp. 611-636.

Kryzanowski, L. and Zhang, H., 1996. Trading Patterns of Small and Large Traders Around Stock Split Ex-Dates. *Journal of Financial Research,* 19(1), pp. 75.

Kumar, A. and Charles, M.C.L., 2006. Retail Investor Sentiment and Return Comovements. *The Journal of Finance,* 61(5), pp. 2451-2486.

Lamoureux, C.G. and Poon, P., 1987. The Market Reaction to Stock Splits. *The Journal of Finance,* 42(5), pp. 1347-1370.

MacKinlay, A.C., 1997. Event Studies in Economics and Finance. *Journal of Economic Literature,* 35(1), pp. 13-39.

Maloney, M.T. and Mulherin, J.H., 1992. The Effects of Splitting on the Ex: A Microstructure Reconciliation. *Financial Management,* 21(4), pp. 44-59.

McNichols, M. and Dravid, A., 1990. Stock Dividends, Stock Splits, and Signaling. *The Journal of Finance,* 45(3), pp. 857-879.

Merton, R.C., 1987. A Simple Model of Capital Market Equilibrium with Incomplete Information. *The Journal of Finance,* 42(3), pp. 483-510.

Muscarella, C.J. and Vetsuypens, M.R., 1996. Stock splits: Signaling or liquidity? The case of ADR 'solo-splits'. *Journal of Financial Economics,* 42(1), pp. 3-26.

Niemeyer, J. and Sandås, P., 1995. An Empirical Analysis of the Trading Structure at the Stockholm Stock Exchange. *Journal of Multinational Financial Management,* s 63 - 101.

Pandey, J., Kandpal, V. and Nautiyal, N., 2021. An Analysis of Abnormal Returns Associated with Stock Split. *Singapore Economic Review,* , pp. 1-14.

Woolridge, J.R. and Chambers, D.R., 1983. Reverse Splits and Shareholder Wealth. *Financial Management,* 12(3), pp. 5-15.

Other Articles:

Björn Suneson, 2008. Enklare Köpa Enstaka Aktier. *Svenska Dagbladet*
https://www.svd.se/a/3b40671b-f217-30b3-8479-3c7152659731/enklare-kopa-enstaka-aktier

Jacob Bursell, 2009. Småsparare Vinnare på Nya Börsregler. *Svenska Dagbladet*
https://www.svd.se/a/43fcba6a-0cdd-3b82-a0e5-9e2b61cd204b/smasparare-vinnare-pa-nya-borsregler

Government Publications & Reports:

European Commission, 2017. Commission Delegated Regulation (EU) 2017/588. *Official Journal of the European Union*
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0588&rid=1

Finansmarknadsrådet, 2008. Svensk Värdepappersmarknad i Förändring - Konsekvenser för Finansplatsen vid Ägarskifte i OMX, *Regeringen*
https://regeringen.se/contentassets/bcac31b797a045139b00e087da5d9950/svensk-vardepappersmarknad-i-forandring---konsekvenser-for-finansplatsen-vid-agarskifte-i-omx

Konkurrensverket, 2023. Finansmarknaden - Konkurrens i Kristider
https://www.konkurrensverket.se/globalassets/dokument/informationsmaterial/rapporter-och-broschyrer/analys-i-korthet/analys-i-korthet_2023-2.pdf

Webpages:

Avanza Bank, no date. Våra courtageklasser. Retrieved 2023-05-09.
https://www.avanza.se/konton-lan-prislista/prislista/courtageklasser.html?gclid=CjwKCAjw3ueiBhBmEiwA4BhspNGZM9frItc2ELoA-5mJAC5s1X-F2SkGTPOq0JowJrWw_9wkWEd0-hoCx34QAvD_BwE&gclsrc=aw.ds

Danske bank, no date. Prislista Värdepappershandel. Retrieved 2023-05-09.
https://danskebank.se/PDF/mifid/Prislista_vardepapper.pdf

European Commission, n.d. Investment services and regulated markets. Retrieved 2023-05-10.
https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/financial-markets/securities-markets/investment-services-and-regulated-markets_en

European Securities and Markets Authority, n.d. Article 49 Tick Sizes. Retrieved 2023-05-10.
https://www.esma.europa.eu/publications-and-data/interactive-single-rulebook/mifid-ii/article-49-tick-sizes

Handelsbanken, no date. Prislista aktier och värdepapper − för köp i appen och på internetbanken. Retrieved 2023-05-09.
https://www.handelsbanken.se/sv/privat/prislista-for-privatpersoner/prislista-spara/prislista-vardepappershandel

Länsförsäkringar, no date. Prislista privat. Retrieved 2023-05-09.
https://www.lansforsakringar.se/4ac94c/globalassets/aa-global/dokument/prislistor/08198-prislista-privat.pdf

Nasdaq, n.d.(a) Limit order. Nasdaq. Retrieved 2023-05-12.
https://www.nasdaq.com/glossary/l/limit-order

Nasdaq, n.d. (b) Depth of book - getting the full view. Nasdaq. 2023-05-12.
https://www.nasdaq.com/articles/depth-of-book%3A-getting-the-full-view-2018-09-27

Nasdaq, n.d.(c) Tick Size and Trading Lots. Nasdaq. Retrieved 2023-05-12.
https://nasdaqbaltic.com/market-information/tick-size-and-trading-lots/

Nasdaq, 2019. Intelligent ticks. Nasdaq. Retrieved 2023-05-12.
Intelligent-Ticks.pdf (nasdaq.com)

Nordea, no date. Så fungerar vårt courtage. Retrieved 2023-05-09.
https://www.nordea.se/privat/produkter/spara-investera/aktier/prislista-vardepapper.html

Nordnet, no date. Prislista. Retrieved 2023-05-09.
https://www.nordnet.se/se/kundservice/prislista?gclid=CjwKCAjw3ueiBhBmEiwA4BhspGflorY4DvCr9DlhnVkE2KHpHdd_0KtttorZgKh-phKK-yWBjZxKNxoC5h0QAvD_BwE

NYSE, n.d. Explaining Parity/Priority. Retrieved 2023-05-13.
https://www.nyse.com/article/parity-priority-explainer

Pareto Securities, no date. Prislista. Retrieved 2023-05-09.
https://www.paretosec.se/prislista-handel?gclid=CjwKCAjw3ueiBhBmEiwA4BhspPGQa_R6yCDaIY9nVu2GjlHLvRUScoFY45gCnCgyCYAZu8NNcBFbVhoCWfsQAvD_BwE

SEB, no date. Courtage. Retrieved 2023-05-09.
https://seb.se/privat/spara-och-placera/aktier-och-andra-placeringar/courtage

Sharkey, 2022. What is a brokerage fee?. Nasdaq. Retrieved 2023-05-12.
https://www.nasdaq.com/articles/what-is-a-broker-fee

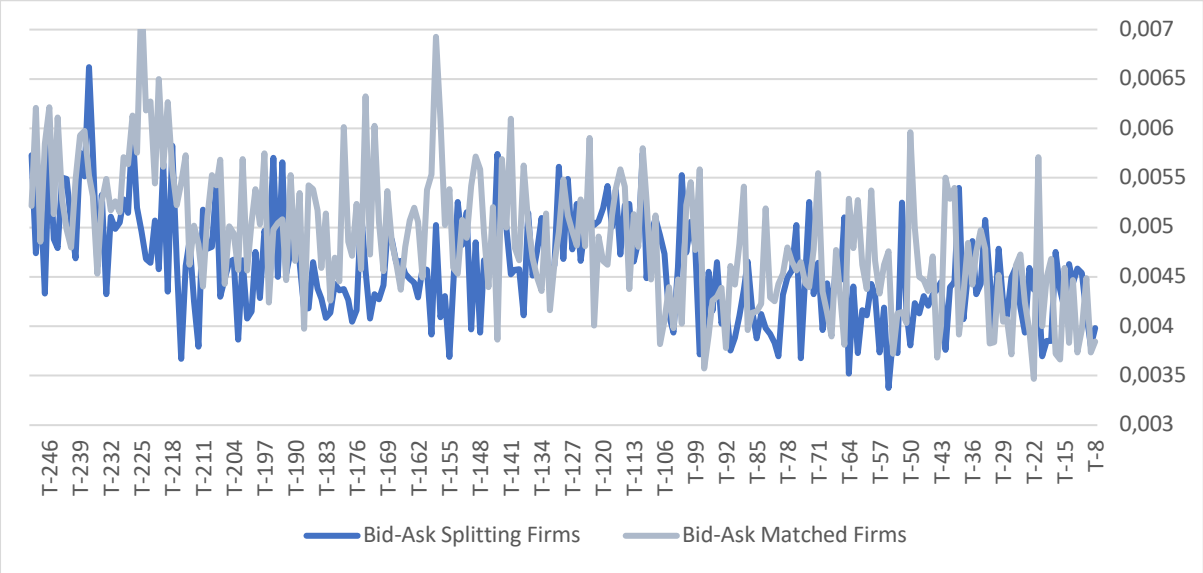
Swedbank, no date. Courtage för värdepappershandel i app och internetbank. Retrieved 2023-05-09.
https://www.swedbank.se/privat/spara-och-placera/aktier/courtage.html

Tomas Karlsson, 2018. Tick Size - Vad är det? *Swedbank Aktiellt* Retrieved 2023-05-09.
https://www.swedbank-aktiellt.se/2018/januari/tick_size_vad_ar_det.csp

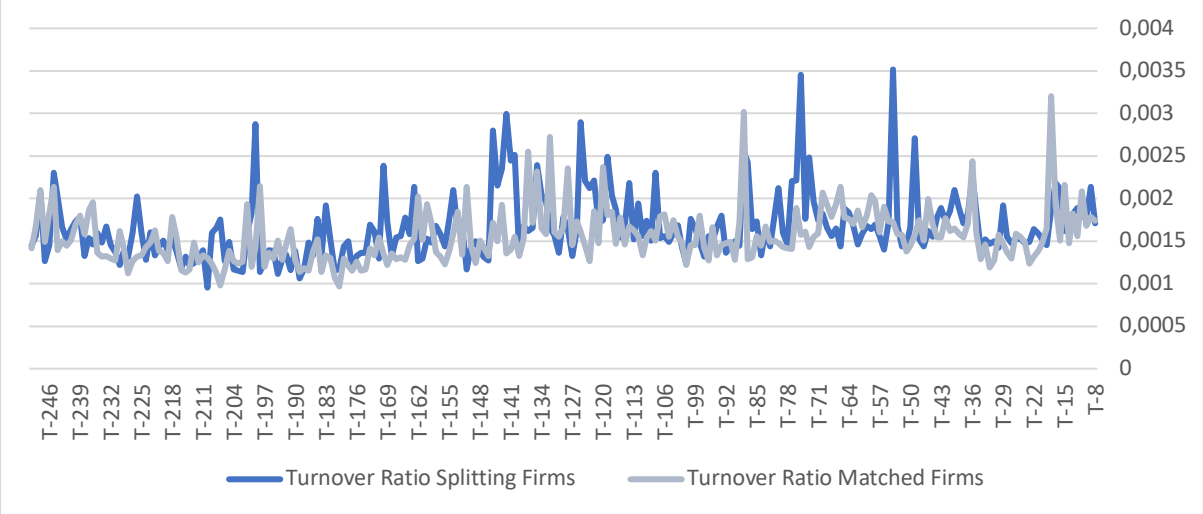
9. Appendix

Appendix A: Aggregate liquidity metrics for the observation and control firms in the benchmark period

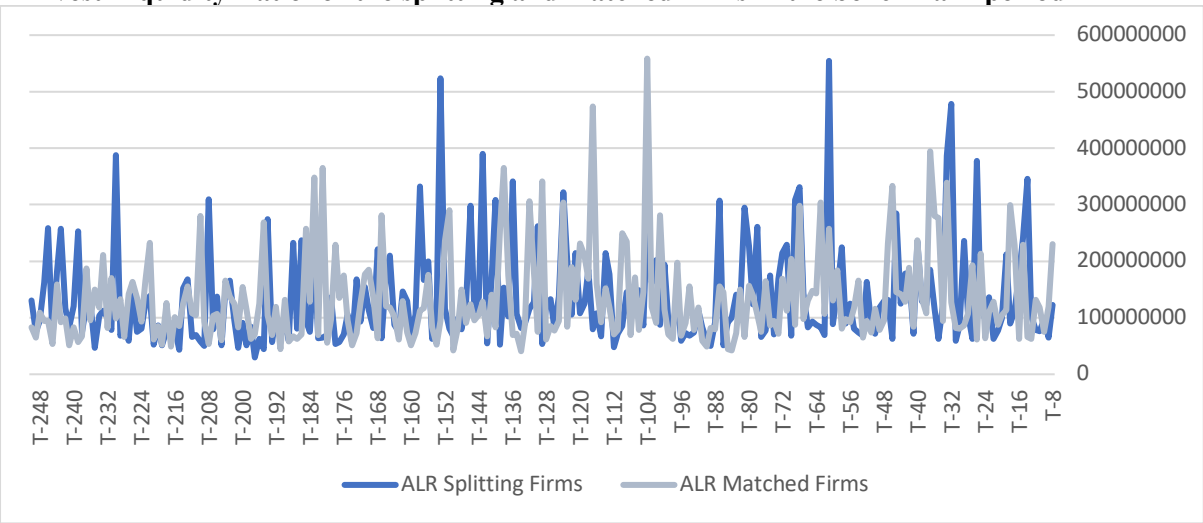
Bid/Ask Spread for the splitting and matched firms in the benchmark period



Turnover/Mcap for the splitting and matched firms in the benchmark period



Amivest Liquidity Ratio for the splitting and matched firms in the benchmark period



Appendix B: List of observation firms

Firm	Split date	Split ratio	Matched firm
XANO Industri AB	6/11/2019	2:1	BICO Group AB
XANO Industri AB	6/8/2017	2:1	K2A Knaust & Andersson Fastigheter AB
Wihlborgs Fastigheter AB	5/23/2018	2:1	Granges AB
Wallenstam AB	5/25/2015	2:1	Industrivarden AB
Vitrolife AB	5/17/2018	5:1	Lifco AB
Unibet Group PLC	1/4/2016	8:1	Saab AB
Troax Group AB	6/18/2019	3:1	Stendorren Fastigheter AB
Systemair AB	9/6/2021	4:1	Ferronordic AB
Swedish Match AB	5/7/2021	10:1	Skandinaviska Enskilda Banken AB
Sweco AB	11/10/2020	3:1	Thule Group AB
Svolder AB	1/14/2022	4:1	Medicover AB
Svolder AB	12/14/2017	2:1	AddLife AB
Svenska Handelsbanken AB	5/19/2015	3:1	Svenska Cellulosa SCA AB
SkiStar AB	1/16/2019	2:1	Catena AB
Sinch AB	6/17/2021	10:1	Skandinaviska Enskilda Banken AB
Sectra AB	10/18/2021	5:1	Bravida Holding AB
Proact IT Group AB	5/19/2021	3:1	NP3 Fastigheter AB
OEM International AB	5/3/2021	4:1	Proact IT Group AB
Nolato AB	5/12/2021	10:1	Instalco AB
Nibe Industrier AB	5/25/2021	4:1	Swedish Orphan Biovitrum AB
Nibe Industrier AB	5/27/2016	4:1	Nobia AB
NGS Group AB	5/19/2017	4:1	Stillfront Group AB
Nederman Holding AB	5/15/2018	3:1	OEM International AB
NCAB Group AB	12/28/2021	10:1	NP3 Fastigheter AB
Lifco AB	5/6/2021	5:1	Thule Group AB
Lagercrantz Group AB	10/6/2020	3:1	Concentric AB

K-Fast Holding AB	6/7/2021	6:1	Stendorren Fastigheter AB
ITAB Shop Concept AB	5/21/2014	2:1	Beijer Alma AB
ITAB Shop Concept AB	5/26/2016	3:1	IAR Systems Group AB
Investor AB	5/19/2021	4:1	Atlas Copco AB
Investment AB Öresund	5/11/2016	2:1	Beijer Ref AB
Investment AB Latour	6/20/2017	4:1	Avanza Bank Holding AB
Instalco AB	1/27/2022	5:1	Lindab International AB
Holmen AB	4/30/2018	2:1	Hufvudstaden AB
HMS Networks AB	6/1/2017	4:1	KABE Group AB
Hexagon AB	5/19/2021	7:1	SKF AB
HEBA Fastighets AB	6/4/2019	2:1	SinterCast AB
Garo AB	5/25/2021	5:1	HMS Networks AB
FastPartner AB	05/28/2018	3:1	Addnode Group AB
Fagerhult AB	6/15/2017	3:1	AddLife AB
Fabege AB	4/26/2018	2:1	Fastighets AB Balder
Evolution Gaming Group AB	5/23/2019	5:1	Loomis AB
Creades AB	4/27/2021	10:1	Garo AB
Boule Diagnostics AB	06/01/2018	4:1	Proact IT Group AB
Bimobject AB	12/2/2016	2:1	MedCap AB
Bilia AB	6/5/2017	2:1	Hansa Biopharma AB
Beijer Ref AB	4/23/2021	3:1	Viaplay Group AB
Beijer Ref AB	4/24/2018	3:1	Catena AB
Beijer Alma AB	5/29/2018	2:1	AQ Group AB
Avanza Bank Holding AB	4/15/2019	5:1	Indutrade AB
Arcam AB	1/20/2014	4:1	Intrum AB
Addtech AB	12/10/2013	3:1	Investment AB Latour
Addtech AB	9/15/2020	4:1	Bonava AB
AddLife AB	5/27/2020	4:1	Sedana Medical AB
Fagerhult AB	5/23/2014	3:1	HMS Networks AB
AAK AB	6/13/2018	6:1	Indutrade AB
Afry AB	6/12/2014	2:1	Avanza Bank Holding AB
Vitec Software Group AB	12/22/2015	5:1	Probi AB
Lagercrantz Group AB	10/5/2015	3:1	Investment Oresund AB
Hexpol AB	5/18/2015	10:1	Billerud AB
Hemfosa Fastigheter AB	5/18/2015	2:1	Ratos AB
Bilia AB	5/27/2015	2:1	Industrivarden AB
Axfood AB	4/17/2015	4:1	Indutrade AB
Assa Abloy AB	6/2/2015	3:1	Investor AB

Appendix C: List of all firms and their mean differences in liquidity metrics between the benchmark period and observation period

Bid-ask Spread			Turnover/Mcap			Amivest		
Firm	**Mean diff**	**P-value**	**Firm**	**Mean diff**	**P-value**	**Firm**	**Mean diff**	**P-value**
Firm 55	-0,845	3.0847e-11	Firm 46	0,208	8.7826e-19	Firm 48	2,405	1.0480e-59
Firm 35	-0,609	9.8047e-20	Firm 48	0,102	1.2470e-13	Firm 35	1,527	4.6535e-35
Firm 45	-0,470	1.7562e-10	Firm 6	0,062	0.0161	Firm 54	1,394	1.0074e-27
Firm 54	-0,411	5.3119e-14	Firm 63	0,062	1.8161e-04	Firm 55	1,302	4.4287e-19
Firm 18	-0,330	6.5844e-11	Firm 54	0,054	0.0780	Firm 18	1,213	1.3383e-19
Firm 29	-0,248	2.0705e-05	Firm 35	0,042	1.6847e-06	Firm 45	1,117	2.1360e-30
Firm 24	-0,247	7.7931e-10	Firm 43	0,036	6.5589e-05	Firm 29	0,972	2.0798e-14
Firm 48	-0,231	6.1387e-14	Firm 37	0,034	0.0272	Firm 43	0,744	1.3640e-15
Firm 26	-0,209	8.7212e-22	Firm 24	0,034	0.0575	Firm 26	0,713	4.9326e-12
Firm 40	-0,185	3.1764e-06	Firm 60	0,034	0.0012	Firm 31	0,694	1.5407e-15
Firm 31	-0,162	5.0796e-12	Firm 7	0,029	0.0182	Firm 27	0,685	7.6488e-11
Firm 23	-0,145	0.0551	Firm 56	0,027	0.0022	Firm 24	0,670	2.1313e-08
Firm 15	-0,130	3.1717e-60	Firm 52	0,026	0.0680	Firm 46	0,656	5.6550e-14
Firm 51	-0,121	0.0031	Firm 4	0,024	0.0030	Firm 21	0,608	1.6105e-10
Firm 59	-0,102	0.0146	Firm 15	0,022	0.6792	Firm 40	0,593	1.9578e-06
Firm 6	-0,078	4.2403e-15	Firm 31	0,013	1.8423e-05	Firm 42	0,589	9.4580e-10
Firm 43	-0,064	4.0878e-04	Firm 23	0,012	0.0838	Firm 23	0,543	2.8443e-05
Firm 46	-0,058	1.7565e-06	Firm 25	0,012	0.4297	Firm 37	0,542	3.9071e-05
Firm 16	-0,058	7.3327e-06	Firm 59	0,011	0.3405	Firm 51	0,539	2.9289e-07
Firm 27	-0,046	0.2953	Firm 2	0,009	0.0468	Firm 52	0,528	1.1563e-04
Firm 10	-0,041	5.3536e-07	Firm 21	0,009	0.3166	Firm 56	0,486	1.2371e-07
Firm 52	-0,040	0.3068	Firm 13	0,008	0.2304	Firm 63	0,449	9.5057e-06
Firm 38	-0,039	0.2047	Firm 32	0,008	0.0398	Firm 25	0,446	4.8637e-06
Firm 2	-0,037	0.6482	Firm 27	0,007	0.4444	Firm 2	0,432	1.9035e-04
Firm 25	-0,033	3.0209e-08	Firm 16	0,007	0.5460	Firm 59	0,431	1.3796e-04
Firm 4	-0,030	0.0038	Firm 42	0,005	0.8372	Firm 14	0,323	9.6421e-05
Firm 60	-0,015	0.0248	Firm 40	0,002	0.6217	Firm 20	0,236	0.0134
Firm 30	-0,015	7.1696e-19	Firm 55	-0,001	0.8848	Firm 49	0,231	0.0301
Firm 9	-0,012	2.0187e-13	Firm 14	-0,002	0.8089	Firm 57	0,225	0.0194
Firm 47	-0,003	0.6727	Firm 12	-0,004	0.5551	Firm 4	0,215	0.0202
Firm 63	-0,002	0.7499	Firm 64	-0,004	0.6252	Firm 38	0,163	0.1330
Firm 20	-0,001	0.8381	Firm 18	-0,005	0.8178	Firm 41	0,146	0.1552
Firm 36	0,004	0.0174	Firm 28	-0,006	0.4646	Firm 30	0,124	0.1824
Firm 56	0,004	0.5060	Firm 45	-0,007	0.6722	Firm 6	0,121	0.1937
Firm 57	0,009	0.6566	Firm 49	-0,007	0.1842	Firm 5	0,119	0.2374
Firm 21	0,013	0.0126	Firm 57	-0,007	0.5138	Firm 10	0,102	0.2927

Firm 32	0,013	0.0554	Firm 30	-0,009	0.0135	Firm 60	0,060	0.5089
Firm 12	0,015	0.4902	Firm 34	-0,009	0.1421	Firm 32	0,059	0.5439
Firm 41	0,017	2.2616e-05	Firm 39	-0,009	0.2830	Firm 15	-0,017	0.8556
Firm 58	0,018	0.7372	Firm 20	-0,010	0.6341	Firm 28	-0,035	0.7173
Firm 28	0,019	0.5788	Firm 8	-0,011	0.1464	Firm 47	-0,043	0.6657
Firm 11	0,028	0.0167	Firm 5	-0,012	0.3725	Firm 9	-0,048	0.6130
Firm 19	0,028	3.8213e-05	Firm 41	-0,016	0.0457	Firm 7	-0,066	0.5466
Firm 61	0,031	0.0266	Firm 29	-0,022	0.5755	Firm 16	-0,073	0.4762
Firm 64	0,033	1.2677e-17	Firm 1	-0,023	3.9988e-14	Firm 3	-0,104	0.2981
Firm 33	0,034	0.0031	Firm 26	-0,024	0.0126	Firm 64	-0,107	0.2358
Firm 62	0,035	0.0345	Firm 10	-0,026	0.0016	Firm 39	-0,136	0.3261
Firm 49	0,045	0.0459	Firm 33	-0,028	0.1395	Firm 53	-0,139	0.1228
Firm 34	0,046	1.8205e-23	Firm 11	-0,030	0.0034	Firm 12	-0,148	0.1027
Firm 42	0,050	6.1841e-07	Firm 3	-0,030	7.3829e-05	Firm 62	-0,165	0.0376
Firm 3	0,051	4.9254e-10	Firm 36	-0,034	8.1474e-11	Firm 36	-0,170	0.0627
Firm 13	0,060	2.5381e-51	Firm 19	-0,046	1.1175e-04	Firm 34	-0,230	0.0067
Firm 37	0,061	0.2049	Firm 47	-0,054	1.4959e-08	Firm 19	-0,339	5.2493e-04
Firm 14	0,066	7.3148e-04	Firm 38	-0,056	4.4346e-04	Firm 61	-0,409	1.4687e-05
Firm 5	0,094	1.2581e-10	Firm 17	-0,059	3.3908e-06	Firm 11	-0,413	5.8335e-06
Firm 8	0,096	0.0013	Firm 58	-0,077	0.0124	Firm 17	-0,422	1.2512e-05
Firm 50	0,101	6.1005e-24	Firm 62	-0,081	1.3291e-09	Firm 58	-0,431	7.3942e-05
Firm 17	0,112	2.8181e-04	Firm 9	-0,092	2.2637e-10	Firm 13	-0,476	7.4244e-08
Firm 39	0,120	0.0072	Firm 53	-0,095	6.1312e-09	Firm 8	-0,602	3.7528e-08
Firm 22	0,273	4.3927e-07	Firm 51	-0,109	0.2446	Firm 50	-0,723	4.2494e-14
Firm 44	0,293	6.8618e-04	Firm 50	-0,115	3.7307e-09	Firm 1	-0,803	2.4750e-14
Firm 7	0,329	3.2574e-13	Firm 44	-0,128	3.8989e-05	Firm 33	-0,960	9.5046e-23
Firm 1	0,359	4.7371e-10	Firm 22	-0,178	7.4139e-07	Firm 44	-0,979	3.4457e-13
Firm 53	0,427	1.0333e-85	Firm 61	-0,202	1.7749e-10	Firm 22	-1,056	1.8308e-22