Master Thesis – Preliminary

Title: Effects of market fragmentation on liquidity

Study programme: MSc in Business
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1. Introduction

This master thesis seeks to investigate the effects of the Markets in Financial Instruments Directive (MiFID) on the stock liquidity in the Norwegian equity market. The directive, which was introduced in November 2007, allowed for trading on alternative trading venues, such as multilateral trading facilities (MTF), in addition to the regulated stock exchanges. This directive therefore facilitated market fragmentation, by allowing alternative trading platforms to compete with the primary exchange. This paper seeks to investigate how the market fragmentation in the Norwegian equity market affected the stock liquidity of the stocks included in the OBX-index on the Oslo Stock Exchange.

1.1 Markets in Financial Instruments Directive (MiFID)
The MiFID replaced the Investment Services Directive (ISD) which was adopted in 1993, and set out a comprehensive regulatory regime with the goal of improving the organisation of investment firms, facilitate cross border trading, and ensure strong investor protection. MiFID abolished the so-called "concentration rule", which implied that countries affected could no longer require investment firms to route orders only to stock exchanges. According to the European Commission, MiFID was needed to replace the ISD as the concentration rule represented a barrier for a competitive trading structure, as well as to attract foreign investors to the European capital markets through stronger investor protection. Stronger investor protection also implies that when executing client orders, investment firms are required to ensure the "best execution" on behalf of their clients (European Commission, 2007).

1.2 MTF
Before the introduction of the MiFID, all orders for Norwegian stocks, including block trades, were sent directly to the Oslo Stock Exchange. This implied a simpler overview of the order book and trades involving Norwegian stocks. The introduction of trading Norwegian stocks on alternative trading venues implied

that each multilateral trading facility created its own order book, which complicated the overview of all executed trades. An MTF must be both pre-trade and post-trade transparent, meaning that all orders must be visible through an order book and that the MTF must provide a real-time overview of trade executions. An MTF offer trading in stocks already listed on an ordinary exchange but cannot list new stocks, meaning that for the Norwegian equity market, the Oslo Stock Exchange will determine which companies fulfill the necessary requirements to have their stock listed on the exchange (Pareto Securities, 2017). Among the multilateral trading facilities where Norwegian stocks can be traded, we find Cboe CXE, Cboe BXE, Turqoise, Nasdaq OMX and Aquis among others.

1.3 Dark Pools

In addition to trading on multilateral trading facilities, MiFID also allowed for trading in dark pools, where orders are usually executed at the mid-spread. The mid-spread is usually calculated using the bid-ask spread from the Oslo Stock Exchange. Trading in dark pools is mostly done by institutional investors, seeking to execute large, anonymous trades as a way of avoiding impacting the market (Pareto Securities, 2017).

1.4 Market fragmentation

The market fragmentation which took place in light of the increased competition created by the MTF's and dark pools, has been evident in the years after the introduction of the EU-directive. According to the Fidessa Fragmentation Index, which seeks to create an unbiased measure of stock fragmentation across primary markets and alternative venues, approximately 50% of the turnover in the stocks included in the OBX-index are traded in alternative venues rather than on the lit Oslo Stock Exchange. The OBX-index includes the 25 most liquid stocks on the Oslo Stock Exchange. The following table illustrates the market fragmentation categorizing the percentage turnover on to the lit (Oslo Stock Exchange and MTF) and dark (dark pools) markets for the years 2008, 2012, 2016 and 2017.

	2008	2012	2016	2017
Oslo Stock Exchange	98,85	67,30	48,49	49,44
Cboe CXE	0,72	16,83	15,67	17,50
Cboe BXE	0,00	6,54	6,90	7,17
Turqoise	0,04	4,41	13,67	6,93
Nasdaq OMX	0,00	1,69	1,61	0,36
Aquis	0,00	0,00	1,67	4,06
Other *	0,00	0,26	0,00	0,01
% Oslo Stock Exchange and MTF	99,61	97,03	88,01	85,47
% Dark pools	0,39	2,97	11,99	14,53
Total	100	100	100	100

*Including DNSE, North Sea, ONSE, MNSE, Burgundy, Nyse Arca.

Table 1: Market fragmentation illustrated by the percentage turnover in the lit and dark markets.
Source: Fidessa Fragmentation Index.

1.5 Market fragmentation and liquidity

The shift from consolidated markets (pre-MiFID) to fragmented markets (post-MiFID) poses a question regarding the effect of order flow fragmentation on stock liquidity on the Oslo Stock Exchange. This research question is of great importance as high liquidity increases the probability of executing an order at the desired price. High liquidity implies that numerous investors are attempting to buy or sell a certain stock on the exchange, making it easier to locate a counterparty willing to accept one's bid. In essence, an exchange should therefore be concerned with attracting bidders, i.e. increase the liquidity, as this would increase the total turnover on the exchange. We therefore seek to investigate the effect of market fragmentation on the stock liquidity on the Oslo Stock Exchange. In addition, our analysis may serve as useful to regulators in other countries where off-exchange

trading is prohibited. As market fragmentation on the Norwegian equity market was not present before the introduction of MiFID in 2007, this event creates an exceptional basis for research of the effects of market fragmentation. This paper will supplement the current available research on this subject, by isolating the effect on the Norwegian equity market.

To address this research question, this paper will examine the liquidity of the Norwegian stocks included in the OBX-index on the Oslo Stock Exchange before and after the introduction of MiFID in November 2007. Said liquidity will be measured by the bid-ask spread on the selected stocks. The bid-ask spread measures the difference between the buy and sell price of a given stock, and therefore presents as a natural measure of liquidity: if numerous investors are attempting to buy or sell a given stock, they will try to outbid each other in order to increase their chances of locating a counterparty, and we would therefore expect the bid-ask spread to be low for a highly liquid stock. An immediate challenge represents itself when considering the financial crisis of 2008. As this event coincides with the observed effects of market fragmentation, it will need to be isolated in order to separate it from the effects of MiFID on stock liquidity in the Norwegian equity market.

The rest of the thesis will be organized as follows. Chapter two consists of a literature review, where we will analyze and assess the research and findings of other articles endeavouring to examine the effects of market fragmentation on stock liquidity. We will discuss the methodological differences of the existing research, and identify possible gaps in the literature. Chapter 3 will present theories related to market fragmentation and stock liquidity, which will be the basis for our hypothesis. Chapter 4 will describe the applied methodology, a statistical hypothesis, and what tests are needed in order to confirm or reject the hypothesis.

2. Literature review

In this chapter we seek to find out how market fragmentation has affected the stock liquidity on the Oslo Stock Exchange by using the findings of other articles. The most relevant article for this study is Gresse (2011) which compares global and local liquidity before and after the introduction of MiFID, for a sample of stock listed on the London Stock Exchange and Euronext. The article seeks to explain how liquidity relates to market fragmentation and internalization. Gresse (2011) finds that market fragmentation improves global and local liquidity, where global liquidity refers to the liquidity of the consolidated trading systems and local liquidity refers to the liquidity of the primary exchange. The study finds that spreads decrease proportionally to market competition. This article also acknowledges the challenge of the financial crisis of 2008 occurring at the same time as the immediate post-MiFID period. Gresse (2011) therefore chooses to study three post-MiFID monthly periods in 2009, avoiding the year 2008 completely. The three monthly periods also denote three different levels of fragmentation. The methodology used consists of two analyses: a panel regression of liquidity measures on to period dummies, and a two-stage regression analysis over the three periods testing the relationship between liquidity measures and fragmentation variables. Gresse (2011) seeks to avoid the effects of the financial crisis by avoiding using periods in the year 2008. However, this method does not guarantee that the effects of the financial crisis on stock liquidity have been isolated: the effects of the financial crisis may extend beyond the year 2008.

O'Hara and Ye (2011) examine how market fragmentation affects market quality in the US equity market, where market quality is measured by effective spreads, realized spreads, and execution speeds across stocks. Their findings show through regression analysis that market quality is not harmed by market fragmentation. Results show that while the US market is fragmented, it is virtually consolidated into a single market, but with many points of entry. This study is based on data collected in the period January 2 - June 30 in 2008. As the analysis considers the US equity market, it is important to discuss whether the data has been distorted by

abnormal market conditions due to the financial crisis. If we consider the event of September 29, 2008 where the Dow Jones Industrial Average fell by 777,68 points in intra-day trading (Twin, 2008), the data period in this study takes place before this event, and we therefore agree with the authors that abnormal market conditions were not present during the data sample. However, this study chooses to focus on the US equity market which may operate under different levels of market conditions and market fragmentation than the European equity market. In addition, the limitations of O'Hara and Ye (2011) also include the fact that the data used in the article is not identified by specific trading venues, making it difficult to determine how differences in trading mechanisms are associated with differences in execution quality.

Foucault and Menkveld (2008) investigate the effects on Dutch stocks from market competition between EuroSETS, the London Stock Exchange and Euronext Amsterdam. Foucault and Menkveld (2008) measure liquidity by market depth. Market depth is defined as the volume of pending orders on the ask and bid side. The results of this article show that liquidity, as measured by market depth, increased when market fragmentation increased. Similarly, Degryse, De Jong, and Van Kervel (2015) investigate the effect of market fragmentation on market depth for large- and mid-cap Dutch stocks. Opposed to the other studies related to this topic, they examine the effects on market fragmentation differentiating between the lit and dark markets. However, in contrast to the related studies on this topic, Degryse, De Jong, and Van Kervel (2015) find that visible fragmentation (fragmentation in the lit market) improves the liquidity of the consolidated market, but *lowers* liquidity at the primary exchange. In line with these findings, a 2001 study conducted by the Securities and Exchange Commission, examines the difference between stocks in the US equity market traded on the consolidated NYSE and on the more fragmented Nasdaq market. Because of differences in market structure, when stocks switch from Nasdaq, a dealer market, to NYSE, an exchange, the order flow becomes more consolidated. Findings show lower effective spreads on NYSE than on Nasdaq. Bennett and Wei (2006) also study the effects of a switch from Nasdaq to NYSE on market quality. Their results reveal improved market quality after the switch to the more consolidated NYSE.

In conclusion, the literature review shows mixed results when considering the effects of market fragmentation on liquidity. The reviewed studies differ on several levels. First of all, the studies do not solely focus on the European equity market. The US equity market may face different market conditions and therefore have dissimilar effects of market fragmentation on liquidity. Furthermore, the reviewed articles have chosen different measures of liquidity; variables such as effective spreads, but also market depth, are used. In addition, several articles differ between measuring liquidity on the global and local level. The effects of market fragmentation due to MiFID cannot be determined from articles where data collected from the US equity market is considered, as the EU-directive is not implemented in the US. This, along with the fact that the EU and US may face different market conditions, leads us to the conclusion that these studies alone cannot explain the effects of market fragmentation on liquidity on the Oslo Stock Exchange. The studies conducted based on solely EU-data also present several challenges. First of all, the primary exchanges of different countries may face different levels of competition. The market fragmentation and competition may have emerged at different speeds, and the competition faced by the Oslo Stock Exchange and for example Euronext can be very different. More noticeably, the reviewed studies have been conducted several years ago. We wish to include more recent data, spanning over several years, in order to capture the effect of market fragmentation on liquidity for the Oslo Stock Exchange for different levels of fragmentation. In addition, several of the reviewed studies have been conducted in a more immediate post-MiFID period, which happened to coincide with the occurrence of the 2008 financial crisis. By investigating our research question a decade after the introduction of MiFID, we are able include several different periods which better equips us to research the effects of market fragmentation on liquidity for the Oslo Stock Exchange.

3. Theory

As discussed in the literature review, empirical evidence show mixed results regarding the effects of market fragmentation on stock liquidity. However, the concept of market fragmentation and its implications have also been widely discussed in theoretical literature. In this chapter we seek to present the various theories developed on this subject. These theories will be the basis for the main hypothesis of this master thesis, which will be formally tested in the upcoming chapters.

One of the first widely used theories on stock liquidity was presented by John M. Keynes (1930). His theory states that a stock is more liquid if it has low volatility and large enough volume to easily absorb large sale orders without considerable price fluctuations. He introduced the idea that the volatility and volume of a stock are highly correlated with the stock's liquidity. In theory, a stock has a higher volume when traded on a centralized exchange than if traded in a fragmented market, across different trading venues. According to his theory, this also applies for the volatility of the stock.

Mendelson (1987) theoretically studied the relationship between market fragmentation, consolidation and market performance. According to the theory presented by Mendelson, market fragmentation can have negative effects on liquidity, as it reduces the benefits of economies of scale. This implies that instead of all orders being directed to one single market place, they will be sent to different venues, and this therefore reduces the probability of executing a trade at each, single location. A single location, like a primary exchange, will therefore experience a smaller total number of buyers and sellers of a stock, which makes it more difficult for a single investor to locate a counterparty which is willing to accept his or hers trade. Mendelsons theory includes an argument that fragmented markets will experience a higher volatility in transaction prices, a reduction in the quantity traded, and reductions in general gains from a trade. We find that these findings are related to the theory presented by Keynes (1930), where low liquidity is accompanied by higher volatility and lower volume. To summarize the

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theoretical argument presented by Mendelson (1987), we find that a market has *network externalities*: it becomes more attractive as the number of traders increase.

The idea behind network externalities is also evident from the theoretical work in Stoll (2003). Along with Mendelson (1987), Stoll argues that the attractiveness of an exchange depends on the number of traders present. This increases the probability of being able to execute a trade at the optimal price. Stoll (2003) argues that centralization will lead to higher liquidity as the average cost of the trade on an exchange will be reduced. Lower costs of trading will attract more traders, and hence, the bid-ask spread will be reduced. Stoll (2003) also finds that the introduction of transparency regulations and competition has reduced some of the advantages of market centralization. Such regulations would encompass transparency of transaction prices and quotes. Increased transparency, stronger investor protection, as well as increased competition, were some of the main reasons for the introduction of MiFID (European Commission, 2007). Stoll (2003) argues that transparency implies traders can find out at which price the stock is trading at all venues, making sure they are able to execute their trade at the best possible price. Stoll (2003) claims that the forces of centralization are being weakened by technology, transparency and fragmentation. The theoretical work of Stoll (2003) was introduced before the implementation of MiFID, and based on the US regulation SEC. However, it still provides theoretical evidence on how regulations, by introducing transparency and fragmentation, have an effect on market liquidity. To conclude, Stoll (2003) argues in favor of centralization when it comes to liquidity by claiming that the forces of centralization are two-fold: on the *supply* side the market reaps economies of scale, and on the *demand* side it generates network externalities.

Based on the theoretical models and implications of market fragmentation on liquidity presented by Keynes (1930), Mendelson (1987) and Stoll (2003), we find that theory supports the notion that market fragmentation reduces liquidity. Therefore, based on the reviewed theoretical works, this master thesis seeks to formally test the hypothesis stating that the presence of market fragmentation,

through alternative trading venues, will cause a reduction in the liquidity on the Oslo Stock Exchange. The chosen methodology used for testing this hypothesis will be described in the following chapter.

4. Methodology

In this chapter, we describe the methodology to be used in order to formally test the hypothesis stated under chapter 3. This master thesis seeks to follow an approach similar to that of Gresse (2011). The first approach to test the effects of market fragmentation on stock liquidity suggested by Gresse (2011) is a panel regression of liquidity measures onto period dummy variables which serve as proxies for level of fragmentation. This is the approach we wish to follow.

4.1 Measure of liquidity

In this master thesis, the liquidity measure to be used will be the quoted bid-ask spread of the stocks traded on the Oslo Stock Exchange. According to Stoll (2003), the bid-ask spread can be used to measure liquidity as well as the cost of trading. Stoll notes that liquidity could also be measured by the time it takes to trade a certain volume of an asset, at the optimal price. However, these two methods converge as the difference between the bid and ask price of an asset can be interpreted as the amount paid to a counterparty to take on the unwanted position and dispose of it optimally (Stoll, 2003). We therefore conclude that a bid-ask spread of an asset is an appropriate measure of asset liquidity.

4.2 Approach

The panel regression approach suggested by Gresse (2011) involves measuring both global and local liquidity by three different liquidity measures: quoted spreads, effective spreads and market depth. Due to considerations of availability of data, this master thesis chooses to focus on local quoted spreads as a measure of liquidity. The approach suggest three explanatory variables to be used in the

panel regression: standard deviation of daily *closing returns* of each stock, the total *trading volume* of each stock, and the inverse of the average primary market's *closing price* of each stock. In addition, Gresse (2011) includes three dummy variables representing three different monthly time periods, which serve as proxies for different levels of fragmentation. We follow this panel regression approach by using the same explanatory variables, as well as including dummy variables as proxies for different levels of market fragmentation. How many dummy variables will be included, and which periods they will represent, will be decided after further examination of the data. We do, however, need to include one, or several, time periods before the introduction of MiFID, where there was no market fragmentation. The approach therefore seeks to investigate the effects of market fragmentation on liquidity, as measured by the bid-ask spread, for several different periods where the market fragmentation was at different levels.

4.3 Interpretation

In order to interpret how market fragmentation has had an effect on the local liquidity, we turn to the coefficients of the dummy variables. Each dummy variable represents a different time period. In Gresse (2011) for example, they represented different monthly periods. A dummy variable representing for example January 2009, would take on the value 1 if the period is January 2009, and 0 otherwise. By running the regression, we can observe the coefficients of the dummy variables. A negative, significant coefficient of for example -0.001 for one of the dummy variables would indicate that in that given month (which represents a certain level of fragmentation), the bid-ask spread is lower and therefore, the liquidity is improved. Similarly, a positive, significant coefficient would therefore imply that the bid-ask spread is higher, and that the liquidity deteriorated. In our analysis, we seek to investigate if the coefficients are positive or negative, using a 5% significance level.

4.4 Justification for explanatory variables

The explanatory variables we will use in our panel regression are those proposed by Gresse (2011), as these variables have been proposed, and used, by numerous

empirical studies seeking to investigate the determinants of bid-ask spreads. This paragraph seeks to explain in what way we believe the three explanatory variables affect the bid-ask spread.

4.4.1 Volume

The trading volume represents the number of stocks traded on a daily basis. As discussed under chapter three, Keynes (1930) believes that one of the determinants of liquidity would be volume, as high volume implies that the market is able to absorb a sale without adverse price changes. Therefore, volume relates to availability of a stock in the market. It has been shown that the higher the trading volume of a stock, the easier it is to execute an immediate exchange (Benston & Hagerman, 1974). The probability for a trader of executing a trade to their desired price, should increase with the trading volume (Tinic & West, 1972). On the basis of empirical and theoretical research, we believe that the trade volume should be an important determinant of the bid-ask spread, as a stock with a higher trade volume should have a smaller bid-ask spread than a stock which is traded less frequently (Bollen, Smith & Waley, 2004).

4.4.2 Return volatility

The return volatility is another variable which we believe has an effect on the bid-ask spread. Return volatility is the measure of the return dispersion for a stock. When a stock has a high volume and is being frequently traded, the risk of the stock is lower than for stocks which are less frequently traded. Volatility of a stock usually increases when there is a decline in the market or there is high uncertainty in the change in the stocks price. When a stock has a low volatility, it implies that the price of the stock will not fluctuate dramatically, but will change steadily over time. A stock with a higher volatility will have a wider bid-ask spread since investors will be less willing to pay a high price for the stock. Spreads will increase because dealers are risk averse (Harris, 1994). Former empirical analysis support our beliefs as it has been proven that when the volatility of a stock is low the bid-ask spread is narrow (Demsetz, 1968).

4.4.3 Stock price

The third explanatory variable to be included in our analysis is the stock price. Why the stock price is in included as a determinant of the bid-ask spread is related to *inventory-holding costs* (Bollen, Smith & Waley, 2004). These are costs which a market maker has. A market maker supplies a market with liquidity by quoting bid and ask prices. Therefore, he acquires a position in a stock when an investor chooses to accept his bid or ask price. The inventory-holding costs of a market maker consist of the opportunity cost of funds tied up in holding an asset, and the risk that this asset will experience unfavourable price changes (Bollen, Smith & Waley, 2004). According to Demsetz (1968), price per share is a proxy for the opportunity cost of funds. The bid-ask spread of a share will increase in proportion to an increase in its price, in order to equalize the cost of transacting (Bollen, Smith & Waley, 2004).

4.5 Data

The required data for this analysis encompasses daily closing prices, traded volume, and the difference between the bid and ask prices for the stocks traded on the Oslo Stock Exchange. In our analysis, we choose to focus on the stocks included in the OBX-index. The OBX-index includes the 25 most liquid stocks traded on the Oslo Stock Exchange (Oslo Stock Exchange, 2018). The reasoning behind this selection is to be able to avoid fusing the effect of market fragmentation on very liquid, and less liquid, stocks. We therefore wish to include only the most liquid stocks traded on the Oslo Stock Exchange. We have confirmed with the Oslo Stock Exchange that the required data for the described approach is available for our use, and that it has been recorded from June 18., 2001 until today's date. After obtaining the data, we need to isolate stocks that have consistently been listed on the Oslo Stock Exchange over the time period to be analyzed, and exclude stocks that haven't from our sample. In addition, we need to ensure that our data sample only includes stocks that are included in the OBX-index over the whole time period which is used.

Bibliography

Bennett, P., & Wei, L. (2006). Market structure, fragmentation, and market quality. *Journal of Financial Markets*, *9*(1), 49-78.

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

Bollen, N. P., Smith, T., & Whaley, R. E. (2004). Modeling the bid/ask spread: measuring the inventory-holding premium. *Journal of Financial Economics*, *72*(1), 97-141

Brooks, C. (2014). *Introductory Econometrics for Finance (3rd Edition)*. United Kingdom: Cambridge University Press.

Degryse, H., De Jong, F., & Kervel, V. V. (2015). The impact of dark trading and visible fragmentation on market quality. *Review of Finance*, *19*(4), 1587-1622.

Demsetz, H. (1968). The cost of transacting. *The quarterly journal of economics*, *82*(1), 33-53

European Commission. (2007). Markets in Financial Instruments Directive (MiFID): Frequently Asked Questions. Retrieved from: http://europa.eu/rapid/press-release_MEMO-07-439_en.htm?locale=en

Fidessa Fragmentation Index. (2018). Fragulator. Retrieved from: http://fragmentation.fidessa.com/fragulator/

Foucault, T., & Menkveld, A. J. (2008). Competition for order flow and smart order routing systems. *The Journal of Finance*, *63*(1), 119-158.

Francotte, P., Valiante, D., & Lannoo, K. (2001). MiFID 2.0: Casting New Light on Europe's Capital Markets. Report of the ECMI-CEPS Task Force on the

MIFID Review. *European Capital Markets Institute and Centre for European Policy Studies.*

Glosten, L. R., & Harris, L. E. (1988). Estimating the components of the bid/ask spread. *Journal of financial Economics, 21(1), 123-142.*

Gresse, C. (2011). Effects of the competition between multiple trading platforms on market liquidity: evidence from the MiFID experience. *SSRN eLibrary.*

Harris, L. E. (1994). Minimum price variations, discrete bid–ask spreads, and quotation sizes. The Review of Financial Studies, 7(1), 149-178.
ISO 690

Keynes, J. M. (1930). Treatise on money, volume 2: applied theory of money.

Lee, R. (2002). Capital markets that benefit investors. A survey of the evidence on fragmentation, internalisation and market transparency. *Oxford Finance Group*, *30*(09), 2002.

Madhavan, A. (1995). Consolidation, fragmentation, and the disclosure of trading information. *The Review of Financial Studies*, *8*(3), 579-603

Madhavan, A. (2000). Market microstructure: A survey. *Journal of financial markets*, *3*(3), 205-258.

Mendelson, H. (1987). Consolidation, fragmentation, and market performance. *Journal of Financial and Quantitative Analysis*, *22*(2), 189-207.

O'Hara, M., & Ye, M. (2011). Is market fragmentation harming market quality?. *Journal of Financial Economics*, *100*(3), 459-474.
Oslo Stock Exchange. 2018. Minileksikon. Retrieved from:
https://www.oslobors.no/Oslo-Boers/Om-Oslo-Boers/Minileksikon#o

Pagano, M (1989). Trading Volume and Asset Liquidity. *The Quarterly Journal of Economics, Vol. 104, No. 2*, 255-274.

Pareto Securities. (2017). Det nye Børslandskapet. Retrieved from:
http://www.paretosec.com/download/produktark/Det%20nye%20b%C3%B8rslandskapet.pdf

Pareto Securities. (2017). Omsetning av OBX-aksjer. Retrieved from:
http://www.paretosec.com/download/produktark/Omsetning-av-OBX-aksjer.pdf

Parlour, C. A., & Seppi, D. J. (2003). Liquidity-based competition for order flow. *The Review of Financial Studies*, *16*(2), 301-343.

Riordan, R., Storkenmaier, A., & Wagener, M. (2010). Fragmentation, Competition and Market Quality: A Post-MiFID Analysis.

Securities and Exchange Commission. (2001). Report on the Comparison of Order Execution Across Equity Market Structures. US Government Printing Office, Washington, DC.

Stoll, H. R. (1978). The pricing of security dealer services: An empirical study of NASDAQ stocks. *The Journal of Finance*, *33*(4), 1153-1172.

Stoll, H. R. (2003). Market microstructure. *Handbook of the Economics of Finance*, *1*, 553-604.

Sarr, A., & Lybek, T. (2002). Measuring Liquidity in Financial Markets. IMF Working Paper. International Monetary Fund. URL:

Tinic, S. M., & West, R. R. (1972). Competition and the pricing of dealer service in the over-the-counter stock market. *Journal of Financial and Quantitative Analysis*, *7*(3), 1707-1727.

Twin, A. (2008, September 28.) Stocks crushed. CNN Money. Retrieved from: http://money.cnn.com/2008/09/29/markets/markets_newyork/