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Liquidity Following MiFID II

Estimating the Effect of Research Unbundling on Norwegian Small- and Mid-Cap Stocks

Henriette Utkilen and Synne Wakeford-Wesmann

Supervisor: Darya Yuferova

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Abstract

MiFID II was implemented in 2018 and requires that cost of research products is unbundled commission fees. An anticipated consequence of the" inducement rule" is reduced coverage of small-and mid-cap stocks. In light of prior literature on the relationship between analyst coverage and stock liquidity, we investigate whether MiFID II has 1) affected the analyst coverage of Norwegian small- and mid-cap stocks, and 2) affected the liquidity of Norwegian small- and mid-cap stocks. Through our empirical analysis, we are not able to estimate a meaningful impact of MiFID II on the number of analysts, with a marginal, insignificant reduction of 0.04 per cent. However, we do find that the liquidity of Norwegian small- and mid-cap stocks has decreased following MiFID II and estimate an increase in the relative Bid-Ask spread of ~100 bps in the subsequent period.

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This thesis is written to conclude our Master's in Finance and education at the Norwegian School of Economics (NHH).

The subject of the thesis was chosen in cooperation with FinansBergen and Nordea Investment Management. Given our interest for the financial markets and previous experience from the sell-side, we found it particularly interesting to further investigate how MiFID II and research unbundling has affected market liquidity. The process has been rewarding both from an academic and industry perspective, due to the invaluable inputs and interesting discussions with NHH faculty members, as well as practitioners who have taken extensive time to discuss the topic with us in-depth.

We would like to thank our supervisor Darya Yuferova for crucial inputs and constructive feedback throughout the process. Furthermore, we want to thank Torgeir Stensaker at Nordea Investment Management, Brett Chappel and Morten Bo Prince for providing us with the necessary foundation to understand and discuss the implications of MiFID II. We are highly appreciative of the support from Greenwich Associates, Hardman&Co and Substantive Research in the UK. Lastly, we are grateful for the many buy- and sell-side firms in Norway who have provided us with valuable feedback on how MiFID II has affected them thus far, and their expectations to the future.

Henriette Utkilen

Synne Wakeford-Wesmann

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1. Introduction

The purpose of this thesis is to analyse whether the introduction of the revised Markets in Financial Instruments Directive (MiFID II) and research unbundling has had an adverse effect on the liquidity of Norwegian small- and mid-cap stocks. We perform a comparative analysis where we first investigate if MiFID II has had an effect on analyst coverage of Norwegian stocks relative to US stocks, with the latter being reasonably unaffected by MiFID II. Second, we study the differences in liquidity between our Norwegian and US portfolios in the period following the implementation of MiFID II.

The revised Markets in Financial Instruments Directive (MiFID II) is the most thorough overhaul of the EU financial market in decades. The comprehensive directive was implemented on 3 January 2018 and is expected to alter the former way of doing business. Despite its apparent importance, the academic works on the impacts of MiFID II on the financial market and its participants are unfortunately negligible. Understandably, we are still at an early point in time and within the complex structures of MiFID II there are a number of effects that will play out over the coming years. Nevertheless, we believe it is important to provide an early analysis of potential effects and provide the market with an academic point of view. This demand has been confirmed through our interviews with practitioners ranging from MiFID II-experts to compliance officers and traders, as well as through our survey of analysts and investment managers. Thus, we hope this thesis will be an important contribution to the early academic works on MiFID II, as well as providing relevant insights for both investors, brokerages and regulators as they continue to cope with MiFID II.

In particular, we seek to examine if the introduction of MiFID II has affected liquidity in the stock market, with a special focus on small- and mid-caps. Market liquidity is a crucial factor for a well-functioning market and refers to how effectively stocks and other financial instruments can be traded. Liquid markets offer enhanced efficiency through improved allocation of economic resources and information (Sarr and Lybeck, 2002). In other words, liquid stocks are an important component for the interplay between buyers and sellers in the market, as well as between investors and the firms issuing securities. If a policy decision, in our case MiFID II, has an adverse effect on this interaction, we believe it is of interest to both market participants and the regulators alike to correct this balance.

MiFID II is a comprehensive legislation which affects the market through several different channels. The purpose of this paper is not to investigate all the potential costs and benefits of MiFID II for all market participants. Rather, we have narrowed the scope down to focusing on the potential liquidity effects following the new inducement rule which requires research to be unbundled.

Historically, research products have been distributed for free with the cost implicitly included in the commission fee. However, with MiFID II regulators require institutional investors to explicitly pay for research, making the cost of research visible for the end-client. As investment managers are faced with an actual cost for research, they are likely to reduce their research expenditure and thus the number of research providers. This causes increased competition amongst research producers and analysts will focus their attention and resources towards research that will be valued by institutional investors. As institutional investors have a preference for larger companies due to requirements on market capitalisation and liquidity (Gompers and Metrick, 2001), a widely anticipated consequence is the reduced coverage of mid- and small-cap companies (Wintermantel et al., 2016). However, the effect of analyst coverage on liquidity is not straightforward. One side proposes that analysts increase the amount of private and public information available about a firm, which decreases the information asymmetries and improves the liquidity (Brennan and Subrahmanyama, 1996)(Roulstone, 2003). Contrary to this notion, Chung et al. (1995) argue that the number of analysts following a stock is related to the amount of information asymmetries and therefore related to reduced liquidity. In this paper, we seek to investigate if MiFID II implicitly affects the liquidity for small- and mid-cap companies by reducing analysts' focus on these companies.

In short, the purpose of this paper is to investigate how research unbundling has affected the liquidity of equities so far. We have chosen to focus on equities in particular, as research unbundling is one of the largest changes for equities following the revised directive. In addition, data on equities is more readily available than e.g. fixed income or FX.

In our empirical analyses, we use the Difference-in-Difference methodology to compare the change in analysts and liquidity, respectively, for two portfolios consisting of Norwegian and US stocks, in two time periods (two- and six-months) before and after the implementation of MiFID II. First, we find that the number of analysts for the whole sample has been reduced by 0.8-0.11 per cent following MiFID II. However, when analysing the change in liquidity for the whole sample, we do not find any conclusive evidence of a difference between NOR and US

stocks following MiFID II. In order to isolate the impact on small- and mid-cap companies compared to large firms, we expand the model to the Difference-in-Difference-in-Difference. First, we find only a marginal, insignificant reduction of 0.04 per cent in the number of analysts. Despite this result, we do find that liquidity of small- and mid-caps has indeed been reduced. We estimate that the bid-ask spread of Norwegian small- and mid-caps have increased by 94 and 99 bps following the implementation of MiFID II, in the two- and six-month period, respectively. In light of the mean values of 95 and 97 bps this is an effect of economical importance as well, as it would increase the spread by 1.3-1.5 standard deviations.

The rest of our paper proceeds as follows: Section II gives an introduction to MiFID II, the liquidity measures we have focused on, and lastly the relationship between analyst coverage and liquidity. In Section III, we describe how we collected and constructed our data sample, and outline the propensity score matching procedure used to establish the control group. In Section IV we introduce the Difference-in-Difference methodology, and assess the key parallel trend assumption. We further present the regression models used in the analyses and provide some descriptive statistics. In Section V we evaluate the results of the regressions and key findings, which are subsequently discussed in Section VI. Lastly, Section VII concludes our work and gives some directions for future research on the topic.

2. Literature review

In the following chapter we will review prior studies relevant for our thesis. First, we give a brief introduction to MiFID II, regulators' motivation and its key areas of impact. Second, we present the liquidity measures and prior research which forms the basis of our empirical study. Lastly, we give an overview of academic works on the relationship between liquidity and analyst coverage, and connect this to our current study on MiFID II and liquidity.

2.1 MiFID II

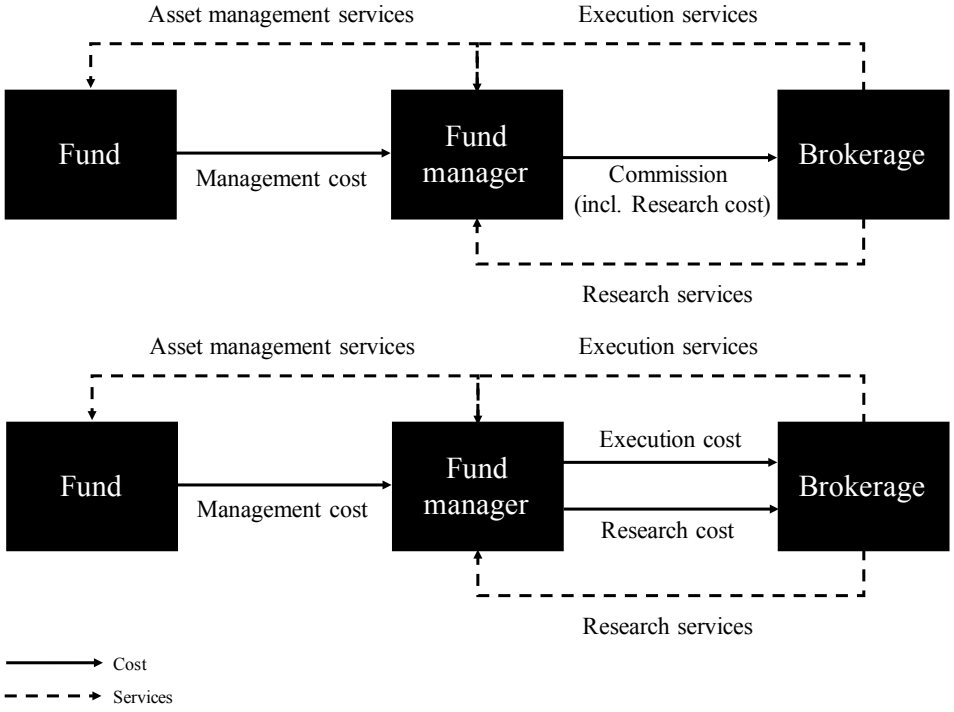
Markets in Financial Instruments Directive II (MiFID II) is an extensive collection of regulations for the EU financial markets, including all asset classes and market participants. The directive was put into force on 3 January 2018 and seeks to improve investor protection, and enhance the functioning of the EU financial market by making it more efficient, transparent and resilient (ESMA, 2019) The original Markets in Financial Instruments Directive (MiFID) was introduced in 2007, as a part of EU-regulators' aim to "improve the competitiveness of the financial markets by creating a single market for investment services and activities" (ESMA, 2018). However, the Financial Crisis which followed shortly after revealed several weaknesses of the current regulation. Thus, the European Commission adopted a legislative proposal for a revised directive, MiFID II, which included an exhaustive range of financial assets and rules applicable to all participants trading in an EU instrument or interacting with an EU firm.

MiFID II is more comprehensive than its predecessor and includes practically all instruments traded on European venues, ranging from equities to carbon quotas and everything in-between. Further, the directive focuses on enhanced reporting standards and investor protection, and investment firms are required to document that they have taken "all sufficient steps" to obtain the best results for their clients (ESMA, 2017). In addition, the directive aims to move dark pool and Over-the-Counter (OTC) trading to electronic, regulated venues in order to improve the transparency of the markets. The overall aim of these requirements is to increase the available information and the visibility for end-investors. Following the financial crisis, regulators found it necessary to restore investor confidence in the financial markets and ensure investors had access to information regarding the costs associated with their investments.

An important part of improving the cost visibility for investors is the inducement rule. MiFID II seeks to unbundle the provision of investment research from execution services (ESMA,

2018). Historically, research has been offered free of charge, with the costs implicitly included in the commission fee. Thus, the cost has been carried by the investment firms' clients rather than the investment firm. Regulators viewed this as a conflict of interest as money managers may be induced to trade with certain brokerages if they provide the best research. Therefore, MiFID II requires that the price of research is unbundled from the execution fee and buy-side firms need to explicitly pay for the research products they receive. Hence, investment firms are encouraged to execute a deal based on the commission fee rather than their relationship with the investment bank or broker, whilst research producers will need to demonstrate that their research provides an actual value-add for investment managers and investors.

Figure 1 – The cost structure of research products pre- and post-MiFID II



Pre-MiFID II, the cost of research products was incorporated in the commission fee and "unknown" to the end-investor who was ultimately paying through the management fee. Post-MiFID II, the execution cost and research cost are separated in order to prevent inducement and increase visibility for the end-client.

The unbundling of research is expected to transform the market place for research. Investment managers are expected cut back on the number of research providers used, which results in reduced profits and higher competition amongst analysts, with a survey indicating a 10-30 per cent reduction in earnings for research providers (Turner et al., 2017). Institutional investors are usually operating under an investment mandate, which dictates the minimum size and liquidity of a stock they can invest in. Thus, institutional investors have a natural preference for larger companies with liquid stocks. Following MiFID II, analysts are expected to focus

their attention towards larger stocks with more institutional interest in order to win the favour of the investment managers. Therefore, a widely expected consequence of the research unbundling rule is the reduced coverage of small- and mid-cap companies (Wintermantel et al., 2016), with 82 per cent of the investment managers in a survey expecting the coverage of small-caps to reduce following MiFID II (RSRCHXCHANGE, 2018).

2.2 Liquidity

In this thesis, the term liquidity is used for the level of a stock's liquidity in the market place. Liquidity is paramount for a well-functioning financial market and refers to how easily an asset can be traded and change hands. Liquid markets are important as the benefits they offer in terms of systematic factors enhance the allocation of economic resources and improve information efficiency (Sarr and Lybeck, 2002).

One common way to define liquidity is as the ability to *"trade large quantities quickly and at a low cost with little price impact"* (Chollete, Næs, and Skjeltorp, 2007). This definition refers to four dimensions used to measure liquidity, namely – depth, immediacy, width and resiliency (Harris, 1990). Width refers to the transaction costs, most often expressed by the spread. High spreads indicate low liquidity and that it is costly to trade, whilst low spreads indicate the opposite. Thus, the spread can be regarded as the price one has to pay to "acquire" liquidity at a given moment. Depth refers to the latter part of the definition, "with little price impact" and the ability to trade large volumes without affecting the price substantially. Investors, and in particular institutional ones, want to be able to buy and sell large quantities without moving the price. Therefore, less liquid stocks are often traded in smaller volumes. The third dimension, immediacy, refers to the time it takes to carry out a transaction. Gabrielsen et al. (2011) argue that a liquid market is related to a "prompt and secure" link between demand and supply of assets. Whilst prompt refers to the time from the seller places the order to it is executed, secure refers to the link between the buyer and seller. More time from the order is placed to executed, as well as more contractual work before the trade can take place are both indicative of an illiquid asset. Lastly, resilience refers to how fast prices return to "normal" following an uninformed and unbalanced order flow (Harris, 1990). If market makers are able to increase the supply of an asset and thus reduce the difference between the market price before and after the unbalanced order, the market is resilient. In summary, a liquid market is characterised by a small width, large depth, decent immediacy and strong resilience.

As evident above, the definition of liquidity is overarching and involves several dimensions. Dick-Nielsen, Feldhütter and Lando (2011) state that "there is no consensus on how to measure the liquidity of an asset, so we examine a number of liquidity-related measures" and Amihud and Mendelson (1991) find that "liquidity is not observed directly but rather has a number of aspects that cannot be captured in a single measure". We agree that in order to capture the different dimensions of liquidity one need to consider several measures. We have therefore chosen to focus on three measures of liquidity – the Bid-Ask Spread, Turnover and Amihud's measure of illiquidity.

The bid-ask spread is the most utilised liquidity measure amongst researchers as it is relatively easy to calculate for securities where the bid and ask prices are quoted regularly (Lesmond, Chen, and Wei, 2007). The bid-ask spread gives the difference between the highest bid-price and the lowest-ask price and is therefore related to the width dimension as it indicates the transaction cost of trading for investors.

Whilst the spread refers to the liquidity ex-ante, turnover relates to the ex-post liquidity (Næs, Skjeltorp, and Ødegaard, 2008). Turnover is a "trading" measure of liquidity, and measures the daily number of traded shares divided by the total number of shares outstanding. Hence, turnover measures the fraction of a company's shares that changes hands on a given day. Similar to the bid-ask spread, turnover is also related to transaction costs through the width element. However, turnover also affects the depth dimension as stocks traded in smaller amounts at a lower frequency will be more affected by large orders than liquid stocks.

Whilst a high turnover rate normally indicates high liquidity, large shifts in turnover volume may occur which give a high turnover rate without liquidity improving. For instance, company specific events or new information may cause fluctuations in a stock which usually has low trading volume. Another example is "block sales" where investors trade large quantities of the stock in one move. Consequently, the turnover should be seen in relation to the stock's volatility (Sarr and Lybeck, 2002). In our analysis, we will control for the volatility of the stocks and assume that an increase in turnover is indicative of improved liquidity.

Amihud (2002) introduces a measure of illiquidity, ILLIQ. ILLIQ is the ratio of a stock's absolute daily return to its daily dollar volume, averaged over a relevant period. The measure estimates the elasticity dimension of liquidity and can be interpreted as the daily stock price reaction to a dollar of trading volume. Amihud's ILLIQ is therefore related to the depth dimension as it measures price impact of trade. Further, Amihud also focuses on the resiliency-

dimension as “illiquidity reflects the impact of order flow on price – the discount the seller concedes or the premium that a buyer pays […] that results from adverse selection costs and inventory”. An illiquid asset is therefore heavily influenced by the trading volume and requires more time before supply and demand drives the price back to a “normal” level following an abnormal trade. As such a high ILLIQ value indicates high illiquidity, whilst a low measure implies a liquid asset.

2.3 Analyst coverage and liquidity

One of the anticipated consequences of MiFID II and unbundling of research is reduced coverage of small- and mid-cap stocks (Turner et al., 2017). In the following, we review earlier academic work on the relationship between analyst coverage and liquidity.

There are several papers on the topic of financial analysts and the liquidity of a firm’s stock. However, prior literature is somewhat divided as to how analyst coverage affects stock liquidity.

Brennan and Subrahmanyam (1995) illustrate that increased analyst following tends to reduce the adverse selection costs of transacting and argue that an increase in analyst coverage increases the market depth due to enhanced competition between informed traders. Similarly, Brennan and Tamarowski (2000) argue that analysts work as “disseminators of information” and show that the number of analysts impacts the trading volume of a stock and thus liquidity. Their hypothesis states that an increase in the number of analysts increases the amount of available private information, which decreases the information asymmetry component of the bid-ask spread. Hence, as more analyst follow a firm the spread lowers, resulting in improved liquidity. In more recent work, Mola et al. (2012) demonstrates how analysts provide value by reducing information asymmetries about future performance and that active coverage maintains investor recognition for the stock. They show that losing coverage can impact both stock performance and liquidity, and that a firm that loses coverage for one year or more is 11 per cent more likely to delist within the next decade than its covered peers. Hence, consistent with the ideas of Merton (1987), the loss of coverage reduces investor recognition and trading in the firm’s stock, which widens the bid-ask spread and decreases trading volume.

Contrary to the papers above, Chung et al. (1995) argue that the number of analysts following a firm increases the spread of the stock, translating to a negative liquidity effect. Illiquid stocks

with greater information asymmetries will have larger analyst followings as the analysts deduce the potential profits from the size of the spread. Simultaneously, market makers deduce the extent of adverse selection costs associated with a stock from the number of analyst followings and set the spread accordingly. Chung et al. shows that there is a positive relationship between the number of analyst followings and the bid-ask spread, indicating higher adverse selection costs for stocks with high analyst following. The paper does however not provide an explanation as to why the adverse selection costs are not reduced by increased analyst followings as one would expect based on the aforementioned papers.

Whilst Brennan and Subrahmanyam (1995) and Brennan and Tamarowski (2000) argue that increased analyst following results in more available private information, Roulstone (2003) shows that analysts reduce information asymmetry by providing public information to market participants. This is in-line with the notion of Easley, O'Hara and Paperman (1998) who show that the number of analysts does not appear to create private information, as stocks with high analyst following do not have a higher relative share of informed trading than stocks with low analyst following. Roulstone (2003) looks at analysts' characteristics and market liquidity and uses liquidity proxies from both Chung et al. (1995) and Brennan and Subrahmanyam (1995). He illustrates that high analyst following and low forecast dispersion are both positively related to market liquidity and argues that this demonstrates the benefits of analyst coverage.

2.4 How may research unbundling affect stock liquidity?

The aim of research unbundling is to increase transparency for the end-investor and enforce best-execution. One key concern regarding the inducement rule is the effect it may have on the liquidity of small- and mid-companies. When investment managers are faced with increased cost of research, their expenditure towards equity research, and thus demand, is expected to be reduced. With increased competition amongst research providers we expect analysts to focus their efforts on stocks where there is demand from large institutional investors. As institutional investors usually have an investing-mandate with requirements regarding the market cap and liquidity in the stock, it is likely that more analyst resources will be pushed towards the large-cap companies and away from small- and mid-cap companies.

As outlined in the previous section, there are literature that shows that analysts have a positive effect on liquidity by dissecting company information and reducing information asymmetries in the market, as well as increasing investor recognition for a stock which again supports

volumes. Through these mechanisms we expect analyst following to reduce information asymmetries and direct trading towards stocks which narrows the spread and increases turnover, both with a positive effect on liquidity. Chung et al. (1995) however argue the opposite and highlight that the number of analysts following a firm is dependent on the amount of information asymmetry as greater asymmetry has higher profit potential. Concurrently, market makers deduce the extent of adverse selection risks by observing the number of analyst followings. Based on this notion, we would expect a high number of analyst followings to have a positive effect on the bid-ask spread, indicating reduced liquidity.

In this paper, we first seek to investigate whether MiFID II and research unbundling has negatively affected the number of analysts following Norwegian small- and mid-cap companies which gives in the following hypothesis and alternative

1a: MiFID II has had a negative effect on the number of research analysts following small- and mid-cap companies due to the research unbundling requirement

1b: MiFID II and research unbundling has not affected the number of research analysts following small- and mid-cap companies

Second, based on the discussion above and given the relationship between the number of analysts and liquidity, we arrive at the following key hypothesis and alternative

2a: MiFID II has had a negative effect on the liquidity of small- and mid-cap companies due to reduced analyst coverage following the research unbundling requirement.

2b: MiFID II and research unbundling has not affected the liquidity of small- and mid-cap companies

3. Data collection and sample construction

In this chapter we give an overview of how we construct our data sample, comprising both the treatment and the control group. First, we outline the reasoning for the choice of sample groups, followed by the collection of data. Second, we introduce the propensity score model (PSM) and the matching procedure used to construct the relevant control group. Lastly, we evaluate the quality of the matching.

3.1 Data collection and sample construction

Our sample consists of two stock portfolios, whereof one has been subject to MiFID II and the research unbundling requirements and the other is unaffected. The treated portfolio should consist of stocks from an EU/EEA country which 1) implemented the inducement rule from 3 January 2018, and 2) did not have similar unbundling requirements before MiFID II. Further, we decided to only include stocks from one EU/EEA country as opposed to several countries within Europe, as there likely exist liquidity differences between EU-countries too. As we are familiar with the Oslo Stock Exchange and its constituents, and had readily available financial information about the equities we focus on Norwegian stocks.

To examine the effect of MiFID II on the liquidity in the stock market we want to compare the portfolio of treated stocks to a similar portfolio of stocks, where the only difference is that the second portfolio has not been exposed to the treatment. Ideally, this would be an EU-country that implemented all or most requirements of the directive *except* research unbundling. However, as all EU/EEA member states incorporated the inducement rule in national requirements or legislation (ESMA, 2018) we look to markets outside of Europe. We considered both the Japanese and Australian markets, but decided that both data and information was easier to obtain for the US market.

US regulators have not decided on how and if US regulations will change following MiFID II. The cost of research is still sold for "soft dollars" with the cost incorporated in the execution fee. The US Securities and Exchange Commission (SEC) has provided market participants with no-action relief waivers to allow US brokerages to accept "hard dollars" from EU money managers for research services (SEC, 2017). In addition, the US market comprises companies within a number of different industries, of all sizes and with different levels of performance, which makes it easier to find a suitable peer company to our portfolio of treated stocks.

As outlined earlier, MiFID II affects all investors trading in European instruments or with EU counterparties. As such, even if non-EU investors are exempt from MiFID II, they will be affected by the new requirements through their everyday business. Further, EU asset managers executing trades with US brokerages need to adhere to the inducement rule, which may also affect US stocks in the same manner as we hypothesis for Norwegian stocks. We seek to mitigate this effect by examining the percentage ownership of EU institutional investors in each of the US stocks. By reviewing the top 20 holders of each stock, we find that the median EU institutional ownership is 3 per cent. Compared to the median institutional ownership of Norwegian stocks of 60 per cent, we find it reasonable to assume that the average US company in our sample has not been materially affected by MiFID II through research unbundling.

3.1.1 Data

The data is extracted from the company data and financial information platforms Datastream, Bloomberg and Factset, and comprises information on all Norwegian and US stocks listed on the Oslo Stock Exchange and three S&P indices; S&P 400, S&P 600 and S&P 500. The data points include price, shares outstanding, market capitalisation, trading volume denoted in USD value and in number of shares, stock volatility, as well as the percentage and geographic distribution of institutional ownership, number of analyst recommendations (proxy for number of analysts) and the company's GICS industry code. We use monthly and daily data in the period from April 2017 to October 2018.

The data is used to construct two portfolios, one consisting of Norwegian stocks, affected by MiFID II, and one comprising US stocks, which will serve as the control group. In the following, we provide further detail on the construction of the two portfolios.

3.1.2 Treatment group

In order to construct the treatment group, we use all 196 stocks currently listed on the Oslo Stock Exchange (OSE) as a starting point. Due to the period of interest, we remove all stocks not listed before April 28, 2017. Further, we remove companies with only a secondary listing on the OSE. As we expect the number of analysts to have an effect on the liquidity of the stock, it is plausible to assume that there would be a limited effect on the stock following MiFID II if the stock had no analyst followings before the implementation of the directive. Therefore, we only include companies with at least one analyst recommendation on average through the pre-treatment period, which reduces the sample of Norwegian stock by 47 companies. Lastly, as the research unbundling requirement only affects institutional investors, we further examine

the percentage of institutional ownership in the remaining Norwegian sample. In order for the treatment group to include the relevant effect, we set an arbitrary threshold of 25 per cent for institutional ownership and remove the companies with institutional ownership below this threshold per April 28, 2017. Overall, these corrections result in a portfolio comprising 110 Norwegian (NOR) stocks, which will serve as the treatment group in the empirical analysis.

3.1.3 Control group

The initial portfolio of US stocks includes all constituents of the three S&P indices; the S&P 600, S&P 400 and S&P 500. The indices cover the small-caps, mid-caps and large-cap stocks, respectively, and comprise 1,506 stocks. We perform the same adjustment measures as in the Norwegian sample, and remove companies which are not listed through the period of interest, have primary listing elsewhere and stocks without at least one analyst recommendation in the period before MiFID II. This results in a portfolio of 1,470 stocks.

In order to construct a valid control group of the US stocks we use matching. Without this matching procedure, the differences in liquidity between our Norwegian and US sample in the period post MiFID II may be caused by differences in observed characteristics rather than the new requirements. In the following section, we outline how one can avoid this bias through propensity score matching. Note that we in the following section focus on the *liquidity* of the two samples rather than the number of analysts. As we ultimately seek to discern if MiFID II has had an effect on liquidity we use this as the basis in our PSM model and the subsequent construction of the control sample.

3.2 Propensity score matching

Propensity score matching (PSM) was introduced by Rosenbaum and Rubin (1983) and is a commonly used method in observational studies to estimate the causal effect of a treatment. A fundamental problem of the design of our empirical study is that we will never be able to observe the counter factual outcome of the treated stocks (Caliendo and Kopeinig, 2008). In other words, we cannot discern how the liquidity of Norwegian stocks would have evolved in the period post January 2018 if MiFID II and the inducement rule had not been implemented. As we use US stocks as a proxy for untreated Norwegian stocks, there is likely to arise a selection bias, which may cause an endogeneity problem, as the liquidity between US and Norwegian stocks is likely to be correlated with the selection for treatment, which in our study

are country specific variables. In order to compare treated and untreated stocks, and enable a causal interpretation of the results, the untreated stocks need to be as similar to our treated stocks as possible (Angrist and Pischke, 2009). By matching treated stocks with untreated stocks with similar pre-treatment characteristics, we can construct pairs of treated and untreated stocks which would have been expected to react in a similar manner if both were treated. Hence, PSM aims to correct for the selection bias and isolate the effect of being treated, enabling us to infer causality. We do however note that there could be unobserved heterogeneity present, which would induce bias to our results (Caliendo and Kopeinig, 2008).

In the following sections, we outline the PSM model and independent variables, as well as the choice of matching algorithm and other specifications. Lastly, we evaluate the quality of the matching and discuss whether the assumptions for the PSM model are satisfied.

3.2.1 The PSM model

To estimate the propensity scores, we use a probit model, as this is the default in the *psmatch2* Stata command. In addition, the logit and probit models often yield similar results in binary treatment cases, which is the case for our study (Caliendo and Kopeinig, 2008). The dummy variable for treatment (D) is the dependent variable, whilst the characteristics serve as our independent variables. Hence, the propensity score measures the probability of being treated conditional on the pre-treatment covariates (Rosenbaum and Rubin, 1983). For more details on the PSM model, please see Appendix A.1.

$$p(x) = prob\ (D = 1|x) = E(D|x)$$

The treatment indicator, MiFID II, is a binary variable which takes the value of 1 if company *i* is subject to treatment and 0 otherwise. In our case, the binary variable indicates whether the stock is NOR or US. We want to compare the potential outcome *Y*, here measured by the relative bid-ask spread, between the groups to investigate the differences in liquidity.

The independent variables in the PSM are covariates that affect the probability of being assigned to the treatment group. We seek to include independent variables that identifies US stocks with similar characteristics as the treated NOR stocks, where the pairs would have had a similar level of liquidity if MiFID II had not been implemented. According to Rosenbaum and Rubin (1983) one should always include variables that are unrelated to exposure, here MiFID II, and related to the outcome, here the BidAsk spread as a proxy for liquidity.

Brookhart et al. (2006) argue that this will decrease the variance without increasing the bias. In our study, we include the following independent variables:

GICS – The industry group is included as we expect stocks within the same industry to be affected by similar macro and industry trends, which again affects the trading patterns and liquidity of the instrument.

Size – Market capitalisation and company size are often linked to differences in liquidity. We include a measure for relative size, where the stocks are grouped into quartiles (1-4) denoting the company's relative size in its respective market. We use the market capitalisation of the companies per 28 April 2017 to categorise the size.

As demonstrated in Table 1, there is a considerable difference in market cap between US and NOR companies. The mean market cap in our NOR sample is USD 2,076.35m, whilst in the US sample it is 8x as large with USD 16,565.65m. Hence, to capture the effect of being a relatively large or small stock in the respective market we use a relative size variable. In our further analysis, companies in the fourth quartile are considered large-cap, whilst companies in the first, second and third are considered small- and mid-cap.

Table 1 – Mean size of the US and NOR samples when divided into four quartiles

	Large cap	Mid- and small-cap		
Quantile	**4**	**3**	**2**	**1**
NOR (Market Cap)	7,374.00	757.34	269.22	88.25
US (Market Cap)	35,505.72	5,931.37	2,496.47	850.82

Table 1 shows the mean market cap (USDm) of the NOR and US sample (pre-matching) in the different quartiles.

Trading volume – Trading volume denoted in the number of shares is included as a higher trading volume often indicate more liquidity, which decreases the bid-ask spread in the market.

Avg. Annualised 10-day volatility – Volatility is expected to affect a stock's liquidity as higher volatility would indicate more uncertainty and thus an increase in the bid-ask spread. As we are investigating a limited period of time, we use the 10-day annualised volatility of the stock to capture the effect of short-lived company and sector specific shocks.

3.2.2 The matching algorithm

After calculating the propensity score for each stock, we need to apply an appropriate matching algorithm to match each NOR stock with an untreated US stock. There are several available matching algorithms, however we have chosen to employ the Nearest Neighbour (NN)

matching algorithm as this is a commonly used and straight forward method. The NN method matches NOR and US stocks based on the estimated propensity scores by pairing the stocks which are closest to each other in terms of propensity scores (Caliendo and Kopeinig, 2008). We further need to specify if we perform the matching *with* or *without replacement*. In other words, whether or not we should allow a US stock to be matched against one or multiple NOR stocks. On the one hand, if there is a large difference in the propensity scores it may be difficult to find a proper match if we do not allow for replacement, which may increase the bias if the algorithm is required to choose another match (Caliendo and Kopeinig, 2008). However, as we have considerably more non-treated stocks than treated, we believe this bias is limited and use nearest neighbour *without* replacement.

3.2.3 Assumptions and matching quality

The PSM model includes some underlying assumptions. First, the conditional independence assumption requires that both the value of the outcome variable is independent of treatment and conditional on the pre-treatment characteristics. As such, when controlling for the pre-treatment variables, treatment is assigned randomly and the selection bias is reduced (Caliendo and Kopeinig, 2008).

Second, the common support assumption states that for each value of x there are both treated and untreated observations. We must therefore ensure that the ranges of the propensity score overlap between the NOR and US stocks. In order to evaluate the common support assumption, we visually inspect the density distribution of the propensity scores for the treated and the unmatched/matched control group. While the distributions differ between the treatment and non-treated group before matching, we find that the distribution of the control group covers the range of the treated group. As such, the matched sample provides a satisfactory overlap between the two distribution, both for the density plot and the histogram. We therefore conclude that the common support condition is satisfied.

Figure 2 – The distribution of the propensity score pre- and post-matching

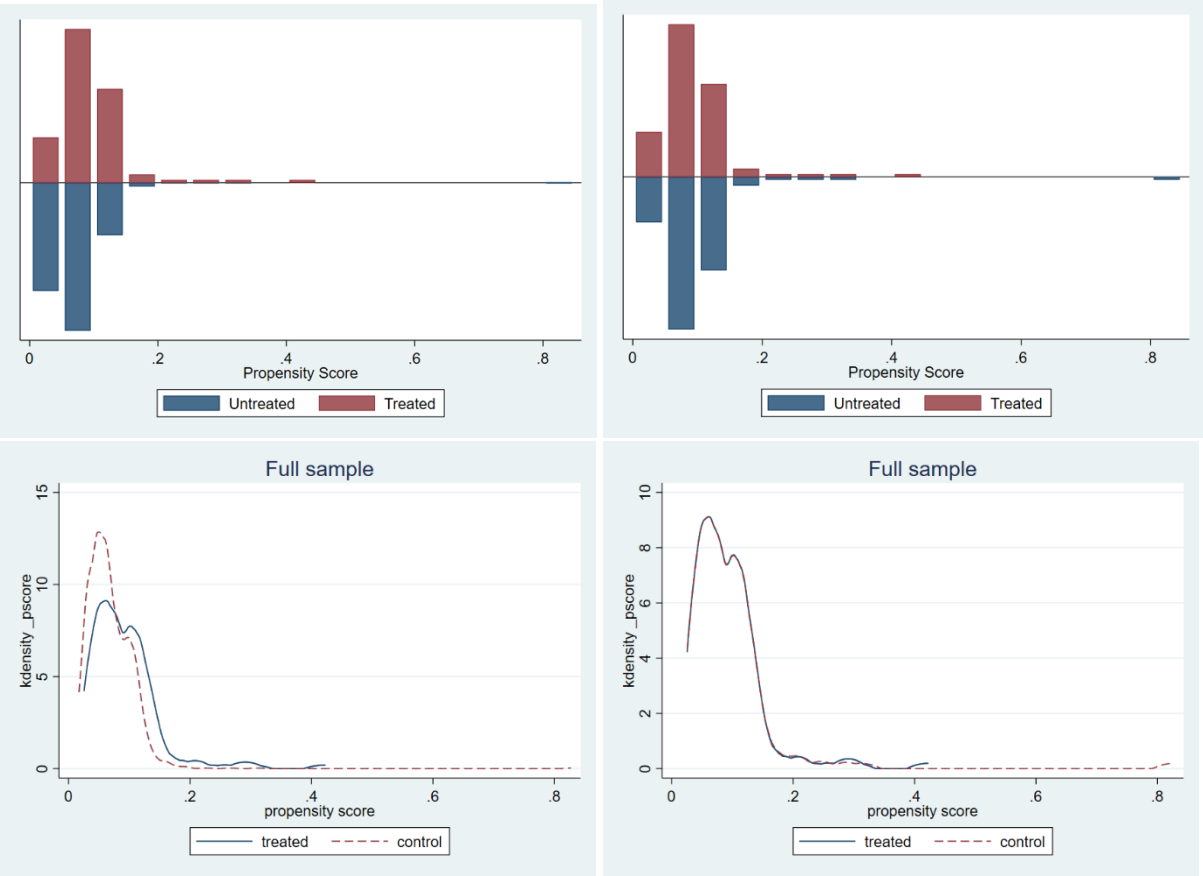


Figure 2 gives an overview of the distribution of the propensity score, before and after performing the matching procedure. The two upper charts show the histograms, whilst the two lower charts show the density plot.

Lastly, the balancing condition requires that given the same propensity score, one should observe the same *x*-characteristics. In other words, we need to evaluate how similar treated and non-treated observations are post-matching based on the pre-treatment characteristics.

When evaluating the characteristics of the two samples in the period before MiFID II before matching, we find clear differences between the groups. As shown in Table 2, there are large variations in minimum and maximum levels. For instance, the volume traded in Norway is seemingly higher, but the standard deviation is lower in the US sample. However, the mean levels are relatively in-line with the largest deviation in the bid-ask spread.

Table 2 – Descriptive statistics pre-matching of NOR vs. unmatched US stocks

	Pre-matching							
	Norway (N: 110)				USA (N: 1,470)			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Propensity score	0.09	0.06	0.03	0.42	0.07	0.04	0.02	0.83
Bid-Ask Spread	0.07	0.09	0.00	0.40	0.54	6.92	0.01	216.16
Size (1-4)	2.50	1.11	1.00	4.00	2.50	1.12	1.00	4.00
Industry (GICS)	7.66	5.34	1.00	21.00	10.50	6.52	1.00	24.00
Turnover (Volume)	0.87	2.80	0.00	24.90	0.51	0.99	0.01	14.90
10-day Volatility	0.31	0.14	0.14	0.89	0.26	0.16	0.00	4.56

** Number of shares traded in millions*

To evaluate the quality of our PSM matching, we investigate if the algorithm has been able to balance the independent variables for the NOR and US stocks. We perform a visual inspection of the means of the characteristics for the treated stocks and the control group post-matching, as well as calculating the absolute standardized bias and t-tests to test for any significant differences in the means between the groups. As reported in Table 3, the observed characteristics are more similar post-matching with none of the means statistically different between the two groups, whilst there were significant differences before the matching. For further details on the t-tests before and after matching, please refer to Appendix A.2. The bias is also lower post-matching. However, it is still quite high for the relative size indicator. Apart from this variable we find that the bias is within the sufficient range of below 3-5 per cent (Caliendo and Kopeinig, 2008). Overall, we find that the propensity score model and the matching algorithm is able to define a control group of US stocks with reasonably similar pre-treatment characteristics as our NOR treatment group.

Table 3 – Descriptive statistics of unmatched and matched US sample

	Post-matching						
	US Stocks			US Control Group			NOR
Variable	Mean	Std. Dev.	Std. Bias	Mean	Std. Dev.	Std. Bias	Mean
Propensity score	0.07	0.038***	7.30	0.10	0.085	4.90	0.09
Size (1-4)	2.50	1.119***	9.80	2.61	1.059	10.00	2.50
Industry (GICS)	10.50	6.518***	2.30	7.80	5.586	2.50	7.66
Turnover (Volume)	0.51	0.989***	6.00	0.99	2.228	5.00	0.87
10-day Volatility	0.26	0.158***	6.50	0.32	0.432	3.00	0.31

**Number of shares traded in million shares*

*Table 3 provides the descriptive statistics for the total sample of US stocks and the matched sample. Based on our chosen variables, we find that the means of the treated NOR stocks and the matched control group of US stocks are **not** statistically different, whilst the unmatched sample of US stocks is significantly different on all measures apart from the relative size. Tests are t-tests comparing the mean value of the treated and the unmatched and matched, respectively.*

4. Methodology

In the following section we outline the methodology used in our empirical study and the underlying assumptions of this method. We then specify our two regression models before we provide some descriptive statistics of the different variables included in the analysis.

4.1 The "Difference-in-Difference" method

If we were to perform two separate regressions for the periods before and after the implementation of MiFID II and subsequently compare the results for Norwegian stocks, the difference cannot be interpreted as the causal effect of MiFID II, and research unbundling in particular, on analyst coverage and liquidity respectively. This is because the number of analysts and the liquidity of the stocks in our sample depends on a number of observable and unobservable factors, and it is unlikely that our model captures all of these. The Difference-in-Difference method is a potential solution to this endogeneity problem as we compare two groups where outcomes are observed for the groups over two periods (Lechner, 2010).

The Difference-in-Difference method (hereby DiD) is suited to evaluate the effect of different policy changes (Imbens and Wooldridge, 2008). The method compares two groups that have a similar trend in the dependent variable before treatment occurs for one of the groups, the treatment group, while the other group, the control group, is unaffected. In our case we will use the DiD method to first analyse whether the number of analysts covering Norwegian stocks have changed significantly due to research unbundling. Second, we use the DiD method to analyse whether the liquidity measures introduced in Section 2.2 have changed significantly for NOR stocks following the implementation of MiFID II and research unbundling, compared to US stocks in the same period.

As introduced in Section 3.1, our treatment group is a portfolio of NOR stocks and the matched portfolio of US stocks will serve as the control group. The Norwegian stocks were exposed to MiFID II in 2018, but not in 2017, whilst the US companies are not affected in either period. Hence, the DiD estimator estimates the effect of MiFID II on analyst coverage and liquidity, respectively, through the difference-in-difference between the treatment and control group in the period before and after the introduction of MiFID II.

As we specifically want to investigate how the MiFID II regulation and research unbundling in particular have affected analyst coverage and market liquidity of small- and mid-cap stocks we further focus on the extended "difference-in-difference-in-difference" method (hereby DDD). The "triple difference" method enables us to separate out the specific effect on one group of the observations in the treatment group (Berck and Villas-Boas, 2016). By adding further interaction terms in the regression, we can capture the specific DDD effect on small- and mid-cap companies in Norway after MiFID II was implemented.

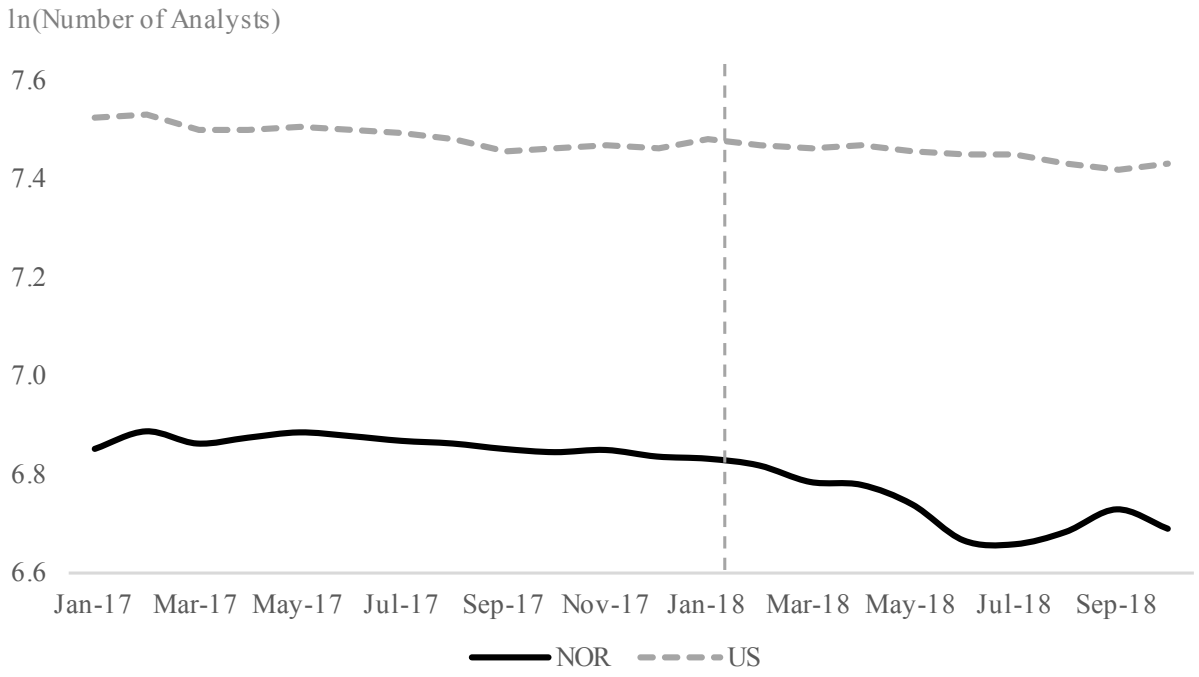
4.2 Assumptions

The DiD model is based on two main assumptions. The first states that the Norwegian stocks in the treatment group should not have experienced any changes in analyst coverage or liquidity due to MiFID II before the policy was implemented in January 2018. Even though the Norwegian market participants were informed about MiFID II several years in advance of the actual enforcement of the regulation, we assume there were limited structural changes ahead of the regulatory change and that the market did not adapt before it was necessary.

The second assumption of the DiD model is the parallel trend assumption. In order for the model to yield trustworthy results, the dependent variable needs to exhibit the same trend in both the treatment and control group in the time period ahead of the policy change (Imbens and Woolridge, 2007). Given the parallel trend assumption, the DiD estimator removes biases in the second period comparisons between the treatment and control group that could occur due to permanent differences between the groups, as well as biases from comparisons over time in the treatment group that could be the result of trends (Imbens and Woolridge, 2007).

In order to check if the parallel trend assumption is satisfied, we evaluate the trend in both the number of analysts and each of the liquidity measures. Note that we use the natural logarithm of the measures as these are the dependent variables included in our empirical study. Further, the US number for the Amihud ILLIQ ratio has been multiplied by 50 in order to give a meaningful comparison of the two trends, as the levels differ considerably.

Figure 3.1 – Trend in the number of analysts



**Number of analysts defined as number of active recommendations*

Figure 3.2 – Trend in the natural log of Amihud's ILLIQ ratio

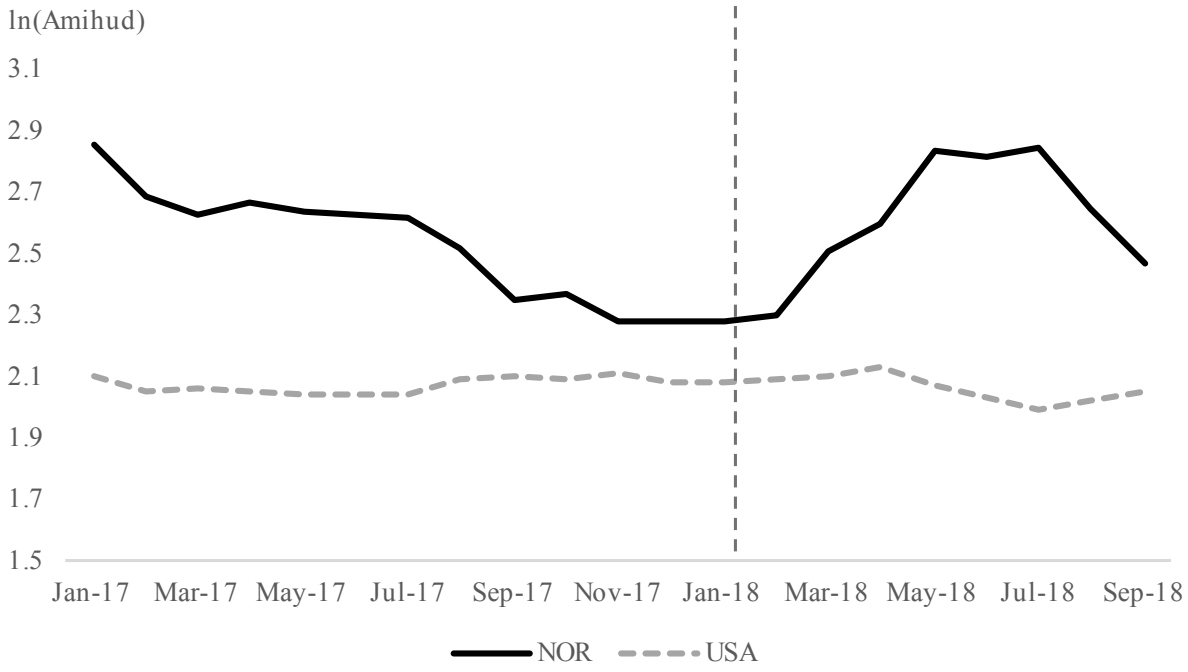


Figure 3.3 – Trend in the natural log of the Turnover measure

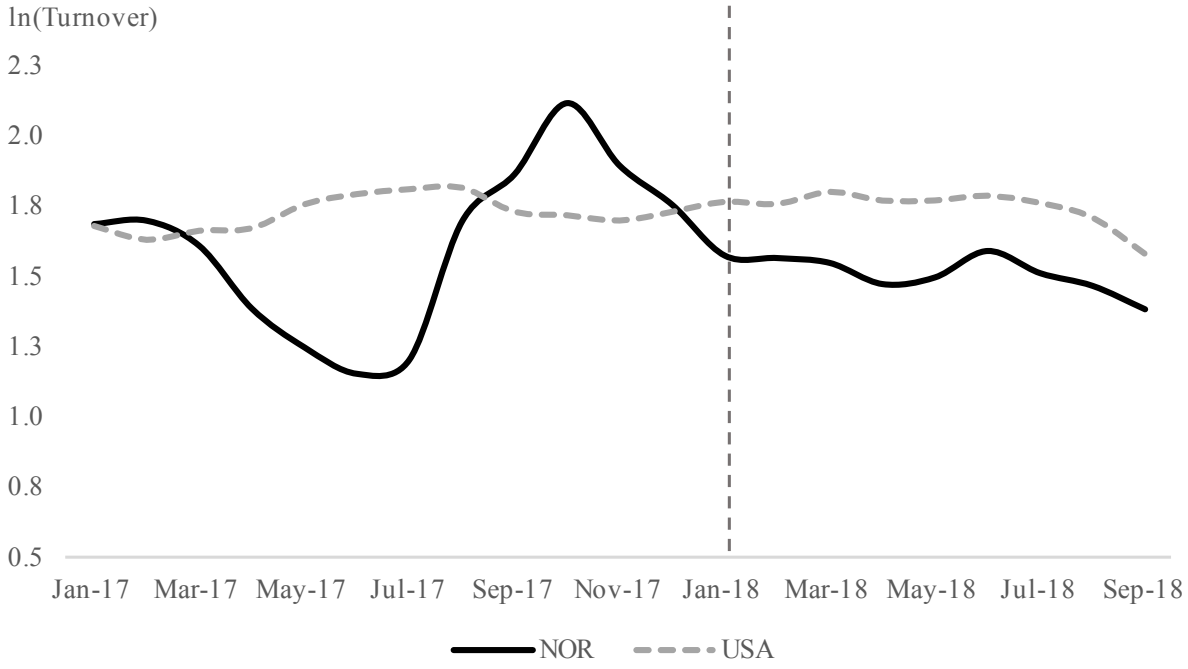


Figure 3.4 – Trend in the natural log of the relative bid-ask spread

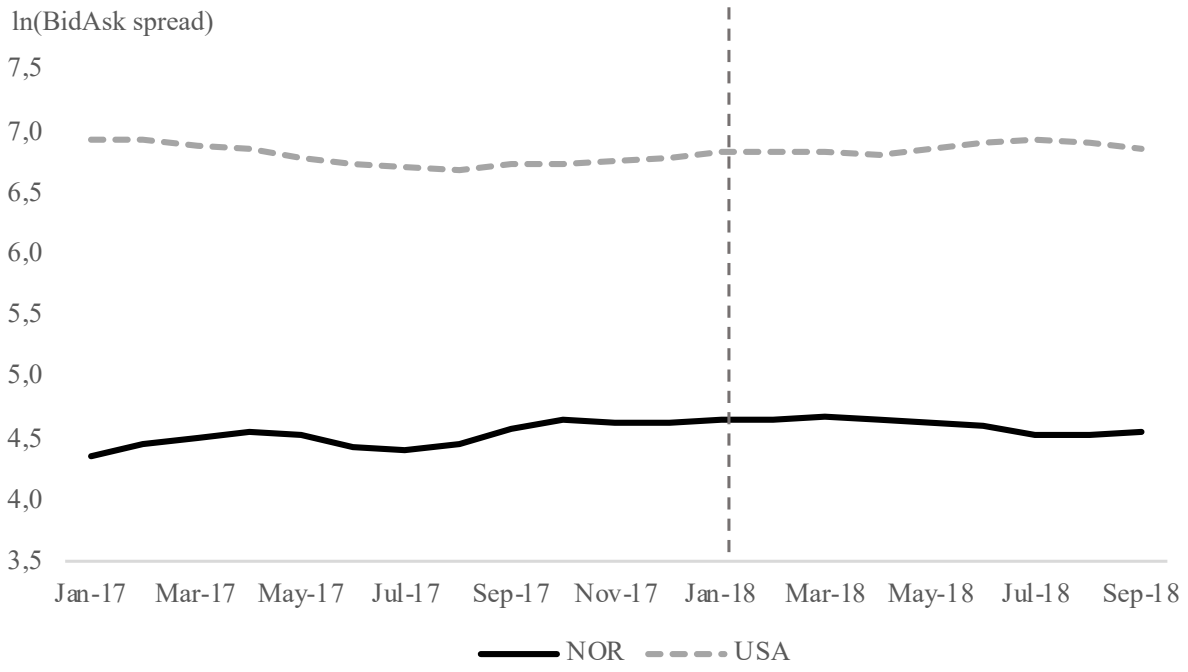


Figure 3.1 shows the development in the number of analyst followings for the companies in the two samples. We observe a similar trend in the number of analysts in the pre-treatment period with a steady development over time in both samples. In the period after MiFID II, we do however see a reduction in the number of analysts for NOR companies, whilst the US sample has had a relatively stable trend. We conclude that the parallel trend assumption is satisfied for the number of analysts.

Observing figures 3.2-3.4 above we cannot conclude that the parallel trend assumption is satisfied for all the liquidity measures. For the Amihud ILLIQ measure the two groups shows a similar downwards trend, but we note that the NOR sample is more volatile than the US stocks, with some clear deviations from the trend. There is however a similar trend path and we conclude that the parallel trend assumption holds for Amihud ILLIQ. Contrary, the Turnover measure demonstrates a clear violation of the assumption, with the trend being more comparable after than before the regulatory change. The turnover of Norwegian stocks varies greatly, whilst US stocks exhibit more stable cycles. Whilst market specifics might explain the volatile trend in our Norwegian sample, we conclude that the assumption does not hold, and we need to exhibit great caution when evaluating the results from the analyses with turnover as the dependent variable. Lastly, the trend for the relative bid-ask spread is close to parallel and we see the same trend path in both samples. We therefore conclude that the parallel trend assumption is satisfied for the bid-ask spread.

4.3 The DD and DDD regression models

In the empirical analysis we seek to estimate the effect of MiFID II on the analyst coverage and liquidity of Norwegian stocks respectively, with a particular focus on small- and mid-cap companies. In this section we will present the relevant regression models.

4.3.1 Regression models – Analyst coverage

To examine the general effect of research unbundling on analyst coverage of Norwegian stocks we want to compare the number of analysts in the treatment- and control group before and after MiFID II was introduced in 2018. The regression model we run is presented in equation (1).

$$(1) \qquad Analysts = \alpha + \beta Norway + \gamma MiFID\ II + \delta(MiFID\ II * Norway) + \rho X_i + \varepsilon_{it}$$

In our hypotheses, we focus on the effect on small- and mid-cap stocks in particular. In order to estimate this effect, we use an expanded DDD regression model that includes an interaction

term that captures the change in the number analysts for small- and mid-cap companies. Equation (2) presents the regression model we use in the DDD estimation.

$$(2) \quad Analysts = \alpha + \beta Norway + \gamma MiFID\ II + \pi Small\&Mid + \delta(MiFID\ II * Norway) + \theta(MiFID\ II * Small\&Mid) + \vartheta(Norway * Small\&Mid) + \mu(MiFID\ II * Norway * Small\&Mid) + \rho X_i + \varepsilon_{it}$$

$Analysts$ is the dependent variable in equation (1) and (2). Number of analysts is defined as the number of active recommendations (Buy, Hold or Sell). The change in the dependent variable is calculated over a period of two and six months prior to the implementation from July to December 2017, and then a two-month and six-month period after MiFID II was introduced from February to July 2018. The data we have on number of analysts are monthly data and thus we use monthly values in the regression. We used the log transformed variable in the analysis.

α, the constant term in equation (1) and (2), represents the control group in the time period before MiFID II was introduced to the market.

$Norway$ is a dummy variable that indicates whether the observation belongs to the treatment-group or not.

$$Norway = \begin{cases} 1 \text{ if the company is listed in Norway} \\ 0 \text{ if the company is listed in the US} \end{cases}$$

$MiFID\ II$ is a time dummy which indicates whether the observation can be dated prior to, or after MiFID II was put in force.

$$MiFID\ II = \begin{cases} 1 \text{ if the observation is } after \text{ MiFID II was introduced} \\ 0 \text{ if the observation is } prior \text{ to the introduction of MiFID II} \end{cases}$$

$Small\&Mid$ is a dummy variable in equation (2) which indicates whether the company is defined as a small- or mid-cap company.

$$Small\&Mid = \begin{cases} 1 \text{ if the observation is a small/mid cap company} \\ 0 \text{ if the observation is a large cap company} \end{cases}$$

The coefficient δ for the interaction term between $MiFID\ II$ and $Norway$ in equation (1) estimates the change in number of analysts for the companies that are affected by MiFID II, that is the Norwegian companies. If the interaction term is significant it may indicate that the Norwegian stocks on average have had a change in analyst coverage relative to the US stocks.

The interaction term θ between $MiFID\ II$ and $Small\&Mid$ is a dummy variable in equation (2) that captures the change in analyst coverage for the small- and mid-cap stocks in the time period after MiFID II was introduced.

ϑ captures the interaction between $Norway$ and $Small\&Mid$ and the coefficient is the effect on analyst coverage of being a small- or mid-cap stock in the treatment group.

μ is the coefficient for the interaction term between $MiFID\ II$, $Norway$ and $Small\&Mid$ and this interaction term is the main parameter of interest in equation (2). It estimates the change in number of analysts for the small- and mid-cap companies that are affected by MiFID II.

X_i make up a vector of covariates that can affect the stock's analyst coverage and therefore should be controlled for in the regressions. We use the logged value of the firms' market capitalization and the logged value of the total trading volume.

The last coefficient in the regression is the residual ε_{it} that represents a random error term. We presume that the error term has an expected value of zero, conditional on the variables included in the model $E(\varepsilon_{ist}|s,t) = 0$.

4.3.2 Regression models – Liquidity

To examine the general effect of research unbundling on the liquidity of Norwegians stocks, we want to compare the liquidity of the treatment- and the control group before and after the MiFID II was introduced in 2018. The regression model we run is presented in equation (3).

$$(3) \qquad Liquidity = \alpha + \beta Norway + \gamma MiFID\ II + \delta(MiFID\ II * Norway) + \rho X_i + \varepsilon_{it}$$

In order to estimate the implications for liquidity of small- and mid-cap stocks we run a regression model that includes an interaction term that capture the changes for small- and mid-cap companies. Equation (4) presents the regression model we use in the DDD estimation.

$$(4) \qquad Liquidity = \alpha + \beta Norway + \gamma MiFID\ II + \pi Small\&Mid + \delta(MiFID\ II * Norway) + \theta(MiFID\ II * Small\&Mid) + \vartheta(Norway * Small\&Mid) + \mu(MiFID\ II * Norway * Small\&Mid) + \rho X_i + \varepsilon_{it}$$

$Liquidity$ is the dependent variable in both equation (3) and (4). In our analysis the variable will be represented by the three liquidity measures introduced in Section 2.2 – Turnover, Amihud's ILLIQ and the Relative bid-ask spread.

The liquidity measures are calculated over a period of two months and six months prior to the implementation from July to December 2017, and then a two-month and six-month period after MiFID II was introduced from February to July 2018. We exclude January as small companies often experience a seasonal increase in stock prices in January, the so-called January effect (Moller & Zilca 2008). The liquidity measures are all calculated using one averaged or summarised observation of each liquidity measure per company in the time period before MiFID II was introduced, and similarly for the period after the regulatory change. This gives the same number of observations when we run the regressions over a two-month period, and a six-month period.

Amihud's measure of illiquidity (ILLIQ) is measured by summing the ratio between absolute return and value traded in USD over the days where the stock is traded in the period. It is then divided by number of trading days in the period. A high ratio indicates illiquidity.

$$ILLIQ_p = 10^6 \frac{1}{D_i} \sum_d \frac{|R_{ipd}|}{VOLD_{ivpd}}$$

Where, D_{iy} *is the number of trading days in the measurement period in period* p

R_{iyd} *is the stock return in currency for stock* i *in day* d *in year* y

$VOLD_{ivyd}$ *is the daily trading volume in USD*

Turnover is calculated on a daily basis, using the daily trading volume divided by the number of shares outstanding at that time. The daily turnover is then aggregated by summing the daily ratios over the period to find a ratio for each stock over the periods prior to and after the implementation of MiFID II. The daily turnover is calculated as:

$$Turnover = \frac{Daily\ trading\ volume\ (in\ shares)}{Number\ of\ shares\ outstanding}$$

The last liquidity measure we use as a dependent variable in the regression is a measure of the relative bid-ask spread. We calculate the relative spread for each stock using daily data, and then take the average over the period. The measure is calculated daily as:

$$Relative\ spread = \frac{P_A - P_B}{\hat{P}}$$

$$Where\ \hat{P} = \frac{P_A + P_B}{2}$$

All the measures used for liquidity in our regression are log transformed. We note that none of the observations for either liquidity measure is zero, thus all observations are defined also as log transformed.

The constant term α, the explanatory variables $Norway$, $MiFID\ II$, $Small\&Mid$, the interaction term δ between $Norway$ and $MiFID\ II$, the interaction term θ between $MiFID\ II$ and $Small\&Mid$, the interaction term ϑ between $Norway$ and $Small\&Mid$ and μ the interaction term between $MiFID\ II$, $Norway$ and $Small\&Mid$ are all defined and interpreted in the same manner as for equation (1) and (2) in Section 4.3.1. The only difference is that equation (3) and (4) investigate the effect on liquidity.

X_i make up a vector of covariates that can affect the stock's liquidity and therefore should be controlled for in the regressions. In regression (3) and (4) we use the logged value of the companies' market capitalization, the logged value of the total trading volume, and the average annualised 10-day volatility.

Lastly, the residual ε_{it} represents a random error term. We presume that the error term has an expected value of zero, conditional on the variables included in the model $E(\varepsilon_{ist}|s,t) = 0$.

First, we carry out a DiD analysis using the whole sample. Second, we use the DDD method to investigate the effect on small- and mid-caps in particular. We do this as we hypothesise that research unbundling primarily affects the number of analysts following small- and mid-cap companies, which again would have an effect on liquidity.

4.4 Descriptive statistics

4.4.1 Descriptive statistics – Analyst coverage

Tables 4.1-4.4 present the descriptive statistics for the variables included in the regression regarding the effect of MiFID II on analyst coverage. The tables only show the descriptive statistics for small- and mid-cap stocks, as we are mainly interested in the effect on these stocks. Please refer to Appendix A3.1 for descriptive statistics for the whole sample.

We see that the average number of analysts differ between the NOR and US sample, with the mean being almost twice as high in the US sample, in both the two- and six-month period, as well as pre- and post-MiFID II. We further notice that the mean value for number of analysts has decreased slightly for Norwegians stocks in period after the implementation of MiFID II.

However, we observe a similar negative trend in analyst coverage for the US sample, indicating that there has been an overall decrease in the number of analysts despite MiFID II.

As for the independent variables, the US companies have a higher market cap than the Norwegian, as expected. However, the market cap of Norwegian companies has seemingly increased in the period following MiFID II, whilst the US stocks are relatively unchanged.

Table 4.1 – Descriptive statistics, 2-month period pre-MiFID II

	2-months (PRE-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Number of Analysts	5.67	3.98	1.00	23.00	11.56	8.20	1.00	35.00
Market Cap	399.2	344.4	6.1	1,477.8	3,480.8	3,304.2	139.0	13,294.3
Volume Traded	0.95	3.35	0.00	29.37	0.49	0.89	0.03	4.98

**Market cap (USDm) and Volume traded (m)*

Table 4.2 – Descriptive statistics, 2-month period post-MiFID II

	2-months (POST-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Number of Analysts	5.34	3.86	1.00	23.00	11.49	8.03	2.00	33.00
Market Cap	436.8	381.6	6.4	1,788.5	3,412.9	3,253.9	190.9	12,793.9
Volume Traded	1.03	4.62	0.00	43.40	0.61	1.299	0.03	9.77

**Market cap (USDm) and Volume traded (m)*

Table 4.3 – Descriptive statistics, 6-month period pre-MiFID II

	6-months (PRE-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Number of Analysts	5.64	4.01	1.00	24.00	11.66	8.35	1.00	38.00
Market Cap	409.6	352.5	57.9	1,627.5	3,419.0	3,267.4	114.1	13,754.0
Volume Traded	0.90	3.50	0.00	33.71	0.48	0.93	0.02	7.51

**Market cap (USDm) and Volume traded (m)*

Table 4.4 – Descriptive statistics, 6-month period post-MiFID II

	6-months (POST-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Number of Analysts	5.04	3.70	1.00	23.00	11.45	8.18	1.00	36.00
Market Cap	446.7	410.6	6.2	2,064.5	3,472.8	3,295.0	140.6	13,504.9
Volume Traded	0.92	3.94	0.00	43.40	0.53	1.10	0.02	9.77

**Market cap (USDm) and Volume traded (m)*

4.4.2 Descriptive statistics – Liquidity

Tables 5.1-5.4 show descriptive statistics for the variables that are included in the regression model analysing the effect of MiFID II on liquidity. The presented numbers are for the small- and mid-cap companies in our sample. Please see Appendix A.3.2 for descriptive statistics for the whole sample. Table 5.1 and 5.3 show the characteristics in the treatment and control group before MiFID II for the two-month and six-month time periods, respectively, whilst Table 5.2 and 5.4 presents the descriptive statistics post MiFID II.

We see from Table 5.1-5.4 that there are clear differences between the mean values for the different liquidity measures between the treatment group of Norwegian stocks and the US control group. For all three liquidity measures, the statistics of the mean values show that the control group is more liquid than the treatment group, both before and after MiFID II. The US companies have a smaller mean ILLIQ ratio and thus are less illiquid on average. The mean values for turnover are higher in the US than in Norway both before and after MiFID II. Lastly, we see that the relative bid-ask spread levels are on average higher in the Norwegian market compared to the US.

On a purely descriptive basis, we find that the mean value for the ILLIQ measure for the Norwegian sample has increased after MiFID II both for the two-month and six-month period, indicating a reduction in liquidity. Contrary, it is not as clear how the turnover of the stocks in our sample has evolved over time. In the six-month period, the mean value has increased post MiFID II, whilst it has decreased in the two-month period. Thus, there are no clear indications as to how the level of turnover in the Norwegian stock market has developed in the relevant time period. Lastly, the mean value of the relative bid-ask spread is higher post MiFID II for both time periods, which could point in the direction of Norwegian stocks becoming less liquid post MiFID II.

The descriptive statistics also show that company size measures by market capitalisation is on average 8x bigger for the control group compared with the treatment group for the small- and mid-cap companies. This is as expected given the large differences in market cap in the US and NOR market and the key reason for why we used a relative size measure when constructing the control group.

Table 5.1 – Descriptive statistics, 2-month period pre-MiFID II

	2-months (PRE-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Amihud ILLIQ	9.19	22.78	0.001	118.23	0.14	0.15	0.01	0.89
Turnover	0.098	0.119	0.001	0.523	0.144	0.123	0.037	0.738
Relative Bid-Ask Spread (bps)	95.3	70.1	11.2	524.3	11.4	26.2	1.0	227.5
Market Cap	399.4	345.4	6.1	1,460.9	3,480.2	3,310.5	149.0	13,084.8
Volume Traded	0.95	3.24	0.00	23.36	0.49	0.88	0.03	4.85
Ann. 10D Volatiliy	36.4	18.0	12.5	103.1	35.9	23.7	12.5	148.8

**Market cap (USDm), Volume traded (m) and Annualised 10-day volatility*

Table 5.2 – Descriptive statistics, 2-month period post-MiFID II

	2-months (POST-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Amihud ILLIQ	12.53	34.66	0.001	214.07	0.15	0.14	0.005	0.62
Turnover	0.094	0.124	0.001	0.630	0.152	0.111	0.033	0.547
Relative Bid-Ask Spread (bps)	96.6	79.9	10.0	446.3	7.8	10.3	1.2	54.0
Market Cap	436.8	382.1	6.4	1,723.3	3,413.6	3,261.9	198.2	12,777.3
Volume Traded	1.03	4.59	0.00	39.69	0.61	1.29	0.03	8.89
Ann. 10D Volatiliy	36.8	17.6	12.5	113.2	36.8	16.0	18.1	91.0

**Market cap (USDm), Volume traded (m) and Annualised 10-day volatility*

Table 5.3 – Descriptive statistics, 6-month period pre-MiFID II

	6-months (PRE-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Amihud ILLIQ	10.11	22.62	0.001	98.61	0.14	0.15	0.005	0.81
Turnover	0.275	0.375	0.007	1.930	0.414	0.306	0.089	1.516
Relative Bid-Ask Spread (bps)	96.7	65.9	13.2	447.3	11.8	27.1	1.4	235.7
Market Cap	409.9	351.7	6.2	1,417.4	3,416.8	3,267.7	137.5	12,596.9
Volume Traded	0.90	3.37	0.00	26.37	0.48	0.91	0.03	5.54
Ann. 10D Volatiliy	33.3	14.7	13.6	97.5	31.9	20.9	12.5	172.9

**Market cap (USDm), Volume traded (m) and Annualised 10-day volatility (%)*

Table 5.4 – Descriptive statistics, 6-month period post-MiFID II

	6-months (POST-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Amihud ILLIQ	15.32	44.59	0.001	310.16	0.14	0.13	0.004	0.56
Turnover	0.291	0.355	0.005	1.993	0.429	0.289	0.083	1.384
Relative Bid-Ask Spread (bps)	102.6	100.4	11.0	727.1	7.5	9.7	1.2	47.2
Market Cap	446.7	407.3	6.7	1,838.7	3,473.8	3,298.4	186.5	12,519.3
Volume Traded	0.92	3.83	0.00	33.32	0.53	1.06	0.03	7.30
Ann. 10D Volatiliy	38.8	18.1	17.3	120.5	32.3	13.3	17.0	78.7

**Market cap (USDm), Volume traded (m) and Annualised 10-day volatility*

5. Results and Key Findings

In this section we present the results from our two analyses and discuss the estimated effects. The first section gives an overview of the results from the analysis of the effect of MiFID II on the number of analysts, both for DiD and the DDD regressions, where the latter specifically focuses on small- and mid-caps. In the second section, we present the main analysis and investigate if MIFID II has had an effect on the liquidity of Norwegian stocks. Again, we split in the DiD and DDD analyses where the latter focuses on small- and mid-caps.

In our results, we report both the regression model with and without fixed effects. We have controlled for company specific fixed effects, as there are likely to exist unobservable, time-invariant effects that vary across companies. If these unobserved effects are correlated with the liquidity of the stock, the OLS estimator may yield inconsistent results. Our preferred model specification is therefore including the fixed effect adjustment. Thus, we will concentrate our comments regarding the results on the regressions including FE.

5.1 Results – The effect of MiFID II on analyst coverage

In this section we will present the results from the DiD regression model given in equation (1), as well as the results from the DDD regression model from equation (2), both introduced in Section 4.3.1. We are interested in investigating how MiFID II and research unbundling has affected the analyst coverage of Norwegian stocks.

5.1.1 The Difference-in-Difference model

The results from the DiD-model of the effect of MiFID II on research coverage, analysing the whole sample, is given below in Table 6.

Table 6 – Regression results from the DiD model - Number of Analysts

	Period: 2-month		Period: 6-month	
	(1) Analyst	(2) Analyst	(3) Analyst	(4) Analyst
MiFIDII	-0.014	0.002	-0.053**	-0.025
	(0.013)	(0.012)	(0.016)	(0.014)
Norway	0.061		0.055	
	(0.082)		(0.078)	
MiFIDII*Norway	**-0.083****	**-0.077****	**-0.132*****	**-0.111*****
	(0.025)	**(0.024)**	**(0.027)**	**(0.027)**
Log(MarketCap)	0.290***	0.150**	0.290***	0.092*
	(0.030)	(0.056)	(0.029)	(0.042)
Log(Traded Volume)	0.102***	0.010	0.102***	0.017
	-0.027	(0.021)	(0.026)	(0.013)
Constant	4.141***	3.110***	4.168***	2.756***
	(0.143)	(0.366)	(0.140)	(0.272)
Observations	871	871	2603	2603
Adjusted R-squared	0.613	0.038	0.617	0.091
Robust SE, clustered by firm	Yes	Yes	Yes	Yes
Fixed Effects	No	Yes	No	Yes

*Standard errors in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001*

In Table 6 above, we see the regression results for the DiD regression with the natural logarithm of analyst as the dependent variable. For the two-month period (Column 2) we observe a decrease of 0.08 per cent in the number of analysts among Norwegian companies. Similarly, the regression results from the six-month period (Column 4) indicate that the analyst coverage in Norway post MiFID II has declined by 0.11 per cent. The observed effect is significant in both the two- and the six-month period. Thus, the results from the DiD regression indicate that MiFID II has had a negative effect on the number of analysts following Norwegian stocks in the period post-MiFID II, relative to the development in US stocks.

5.1.2 The Triple Difference model

The triple-difference model estimating the impact of MiFID II on the analyst coverage of small- and mid-cap stocks is presented below in Table 7.

Table 7 – Regression results from the DDD model - Number of Analysts

	Period: 2-month		Period: 6-month	
	(1) Analyst	(2) Analyst	(3) Analyst	(4) Analyst
MiFIDII	-0.019	0.010	-0.035*	-0.010
	(0.017)	(0.014)	(0.015)	(0.012)
Norway	0.014		0.045	
	(0.117)		(0.112)	
Small-Mid	-0.141		-0.118	
	(0.136)		(0.133)	
MiFIDII*Norway	-0.045	-0.050	-0.162***	-0.140**
	(0.037)	(0.036)	(0.042)	(0.043)
MiFIDII*Small-Mid	0.006	-0.011	-0.022	-0.021
	(0.022)	(0.021)	(0.025)	(0.022)
Norway*Small-Mid	-0.040		-0.083	
	(0.136)		(0.132)	
MiFIDII*Norway*Small-Mid	**-0.045**	**-0.036**	**-0.042**	**-0.039**
	(0.048)	(0.048)	(0.053)	(0.053)
Log(MarketCap)	0.252***	0.153**	0.254***	0.092*
	(0.042)	(0.058)	-0.041	(0.042)
Log(Traded Volume)	0.104***	0.008	0.105***	0.017
	(0.026)	(0.021)	(0.026)	(0.013)
Constant	4.045***	3.128***	4.065***	2.760***
	(0.167)	(0.380)	(0.163)	(0.271)
Observations	871	871	2603	2603
Adjusted R-squared	0.614	0.040	0.619	0.091
Robust SE, clustered by firm	Yes	Yes	Yes	Yes
Fixed effects	No	Yes	No	Yes

*Standard errors in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001*

Evaluating the results from the two-month period in Column 2 we find that the analyst coverage of small- and mid-cap companies in Norway appear to have a decreased by 0.036 per cent of in the period following MiFID II. Given the results from the six-month period in Column 4 we estimate that MiFID II has reduced analyst coverage of Norwegian small- and mid-cap stocks by 0.039 per cent. As such, both the coefficient on the two- and six-month period indicate that

there has been a 0.04 per cent reduction in the number of research analysts following small- and mid-cap companies. The estimated coefficients are lower than the results for the overall sample, indicating a reduction of 0.08-0.11 per cent in the number of analysts covering Norwegian stocks. However, neither of the coefficients in the triple difference analysis are statistically significant. As such, we cannot conclude that MiFID II and research unbundling has had a significant adverse effect on the analyst coverage of small- and mid-cap companies in Norway relative to the US.

5.2 Results – The effect of MiFID II on liquidity

In Section 5.1, we presented results indicating that the number of analysts covering Norwegian small- and mid-cap stocks has been reduced by 0.04 per cent following MiFID II and research unbundling. However, we note that although the sign of the coefficients alluded to a decline in coverage, the specific effect on small- and mid-caps was not statistically significant. In the following sections, we will present the results from the regression models formulated in equation (3) and (4) presented in Section 4.3.2. We intend to examine how MiFID II has affected the liquidity of Norwegian stocks, with Section 5.2.2 focusing specifically on small- and mid-cap stocks.

5.2.1 The Difference-in-Difference model

Our empirical analysis of the full sample gives rather inconclusive results as to the effect of MiFID II on the liquidity of the Norwegian stocks compared to the US control group. The main regression results are presented in Table 5.1 below.

Table 8 – Regression results from the DiD model – Liquidity (2-month)

	Period: 2-month					
	(1) ILLIQ	(2) ILLIQ	(3) Turnover	(4) Turnover	(5) BidAsk	(6) BidAsk
MiFIDII	0.277***	0.213***	0.052	0.109***	0.058	0.018
	(0.030)	(0.030)	(0.054)	(0.030)	(0.133)	(0.125)
Norway	0.152*		-0.459***		2.257***	
	(0.074)		(0.122)		(0.114)	
MiFIDII*Norway	**-0.180****	**-0.139***	**0.080**	**-0.150***	**0.059**	**0.095**
	(0.061)	(0.061)	(0.084)	(0.073)	(0.137)	(0.130)
Log(MarketCap)	-0.262***	0.176	0.150***	0.377		
	(0.032)	(0.179)	(0.036)	(0.308)		
Log(Traded Volume)	-0.974***	-0.602***			-0.267***	-0.175*
	(0.025)	(0.072)			(0.023)	(0.088)
Avg. 10-day Volatility			0.0298***	0.0094**	0.0198***	0.0001
			(0.005)	(0.003)	(0.004)	(0.008)
Constant	-5.650***	-4.401***	-2.440***	0.517	-8.696***	-6.759***
	(0.159)	(1.171)	(0.195)	(1.966)	(0.134)	(0.354)
Observations	440	440	440	440	440	440
Adjusted R-squared	0.935	0.368	0.344	0.107	0.747	0.008
Robust SE, clustered by stock	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	No	Yes	No	Yes	No	Yes

*Standard errors in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001*

As presented in the table above, we identify a slight reduction in Amihud's ILLIQ measure in the two-month period (Column 2). The change indicates a 0.14 per cent decrease in the *illiquidity* of the overall sample of Norwegian stocks and thus improved liquidity. Contrary, we find that the turnover has been reduced by 0.15 per cent in the same period (Column 4), which implies a reduced level of liquidity. Both effects are significant at a 95 per cent confidence level. Lastly, we see a slight reduction of 0.10 per cent in the relative bid-ask spread (Column 6). However, this effect is not significant and we cannot conclude that there have been any changes in the relative spread of Norwegian stocks compared to the US sample.

Table 9 – Regression results from the DiD model – Liquidity (6-month)

	Period: 6-month					
	(1) ILLIQ	(2) ILLIQ	(3) Turnover	(4) Turnover	(5) BidAsk	(6) BidAsk
MiFIDII	0.187***	0.179***	0.034	0.082**	0.123	0.093
	(0.024)	(0.027)	(0.048)	(0.029)	(0.127)	(0.123)
Norway	0.217**		-0.512***		2.217***	
	(0.078)		(0.115)		(0.109)	
MiFIDII*Norway	**0.0099**	**0.0007**	**0.0478**	**0.0568**	**0.0461**	**0.0185**
	(0.0580)	(0.059)	(0.068)	(0.060)	(0.129)	(0.132)
Log(MarketCap)	-0.279***	-0.314**	0.154***	0.205		
	(0.035)	(0.096)	(0.036)	(0.188)		
Log(Traded Volume)	-0.994***	-0.914***			-0.275***	-0.263*
	(0.027)	(0.105)			(0.022)	(0.122)
Avg. 10-day Volatility			0.0345***	0.0055	0.0234***	0.0053
			(0.006)	(0.004)	(0.004)	(0.006)
Constant	-5.808***	-5.788***	-1.363***	0.415	-8.718***	-7.047***
	(0.171)	(0.710)	(0.190)	(1.218)	(0.146)	(0.310)
Observations	440	440	440	440	440	440
Adjusted R-squared	0.920	0.486	0.399	0.127	0.754	0.022
Robust SE, clustered by stock	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	No	Yes	No	Yes	No	Yes

*Standard errors in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001*

In the six-month period, we find that Amihud's illiquidity measure has slightly increased. However, this effect of 0.001 per cent is negligible and not significant (Column 2). As opposed to the two-month period, the coefficient on the turnover measure now implies that turnover has increased in the period following MiFID II, but this effect is lower than in the two-month period (+0.06 per cent vs. -0.15 per cent) and not significant (Column 4). Lastly, there is an indication of a marginal increase in the spread of 0.02 per cent (Column 6), contrary to the finding in the two-month period. However, this effect is not significant in the six-month period either.

Overall, the results from the empirical analysis of the full sample are inconclusive and give ambiguous results. The two-month model estimates a decrease in the Amihud illiquidity measure of 0.14 per cent, which is equivalent to a slight increase in the liquidity. Concurrently, we find a decrease in turnover of 0.15 per cent that indicates a reduction in liquidity. Also in the six-month period, the signs of the coefficients tell contradicting stories. However, none of the effects in this period are significant. Given the contradicting results and lack of significant

coefficients, we cannot conclude that MiFID II has affected the liquidity of Norwegian stocks when evaluating the full sample.

5.2.2 The Triple Difference model

The triple-difference estimate of the impact of MiFID II on the liquidity of small- and mid-cap stocks are presented below in Table 10.

Table 10 – Regression results from the DDD model – Liquidity (2-month)

	Period: 2-month					
	(1) ILLIQ	(2) ILLIQ	(3) Turnover	(4) Turnover	(5) BidAsk	(6) BidAsk
MiFIDII	0.478***	0.376***	0.007	0.170***	0.512**	0.645**
	(0.049)	(0.050)	(0.056)	(0.049)	(0.192)	(0.194)
Norway	-0.351**		0.017		2.007***	
	(0.127)		(0.198)		(0.165)	
Small-Mid	-0.420**		0.490**		0.516**	
	(0.137)		(0.179)		(0.173)	
MiFIDII*Norway	-0.334***	-0.304***	0.127	-0.046	-0.702***	-0.834***
	(0.064)	(0.061)	(0.094)	(0.093)	(0.199)	(0.201)
MiFIDII*Small-Mid	-0.274***	-0.218***	0.059	-0.082	-0.767**	-0.886***
	(0.058)	(0.056)	(0.067)	(0.054)	(0.242)	(0.243)
Norway*Small-Mid	0.519***		-0.518*		0.403*	
	(0.133)		(0.223)		(0.204)	
MiFIDII*Norway*Small-Mid	**0.217***	**0.226***	**-0.279***	**-0.139**	**0.864*****	**0.988*****
	(0.101)	(0.096)	(0.131)	(0.126)	(0.251)	(0.250)
Log(MarketCap)	-0.318***	-0.207	0.192**	0.397		
	(0.048)	(0.174)	(0.060)	(0.315)		
Log(Traded Volume)	-0.971***	-0.612***			-0.208***	-0.196*
	(0.026)	(0.075)			(0.023)	(0.086)
Avg. 10-day Volatility			0.030***	0.009*	0.015***	-0.003
			(0.005)	(0.004)	(0.004)	(0.007)
Constant	-5.635***	-4.619***	-2.578***	-0.381	-8.834***	-6.707***
	(0.170)	(1.132)	(0.207)	(2.011)	(0.159)	(0.343)
Observations	440	440	440	440	440	440
Adjusted R-squared	0.939	0.382	0.359	0.121	0.78	0.086
Robust SE, clustered by firm	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	No	Yes	No	Yes	No	Yes

*Standard errors in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001*

First, when evaluating the results from the two-month period we find that small- and mid-cap stocks in Norway appear to have a significantly higher ILLIQ ratio in the period following

MiFID II, indicating a reduction in liquidity. We estimate that MiFID II has increased the ILLIQ ratio for Norwegian small- and mid-cap stocks by 0.23 per cent (Column 2). The effect is significant at a 95 per cent confidence level. Further, the turnover of NOR small- and mid-cap stocks seems to have been reduced by 0.14 per cent after the implementation of MiFID II, indicative of lower liquidity in the market (Column 4). However, this effect is not statistically significant. Lastly, the results in Column 6 show that the bid-ask spread has increased by an average 0.998 per cent for small- and mid-caps in the two-month period following MiFID II compared to the two-month period before the implementation. This effect is statistically significant, and is also signifying reduced liquidity in Norwegian small- and mid-caps following the introduction of MiFID II.

Table 11 – Regression results from the DDD model – Liquidity (6-month)

	Period: 6-month					
	(1) ILLIQ	(2) ILLIQ	(3) Turnover	(4) Turnover	(5) BidAsk	(6) BidAsk
MiFIDII	0.332***	0.319***	-0.025	0.141**	0.431*	0.525**
	(0.040)	(0.043)	(0.051)	(0.043)	(0.189)	(0.192)
Norway	-0.400**		0.047		2.031***	
	(0.126)		(0.198)		(0.156)	
Small-Mid	-0.458**		0.561**		0.508**	
	(0.138)		(0.174)		(0.167)	
MiFIDII*Norway	-0.120*	-0.131*	0.108	0.098	-0.724***	-0.720***
	(0.051)	(0.052)	(0.069)	(0.075)	(0.193)	(0.196)
MiFIDII*Small-Mid	-0.194***	-0.189***	0.075	-0.079	-0.748**	-0.829***
	(0.048)	(0.047)	(0.058)	(0.053)	(0.239)	(0.242)
Norway*Small-Mid	0.735***		-0.596**		0.329	
	(0.138)		(0.216)		(0.196)	
MiFIDII*Norway*Small-Mid	**0.178***	**0.181***	**-0.213**	**-0.051**	**0.937*****	**1.016*****
	(0.0896)	(0.089)	(0.112)	(0.105)	(0.246)	(0.247)
Log(MarketCap)	-0.313***	-0.315***	0.210***	0.196		
	(0.051)	(0.093)	(0.058)	(0.187)		
Log(Traded Volume)	-0.991***	-0.921***			-0.214***	-0.275*
	(0.028)	(0.107)			(0.023)	(0.115)
Avg. 10-day Volatility			0.035***	0.005	0.017***	0.002
			(0.006)	(0.004)	(0.004)	(0.006)
Constant	-5.651***	-5.808***	-1.492***	-0.464	-8.831***	-6.973***
	(0.179)	(0.698)	(0.216)	(1.213)	(0.156)	(0.296)
Observations	440	440	440	440	440	440
Adjusted R-squared	0.925	0.494	0.423	0.133	0.784	0.093
Robust SE, clustered by firm	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	No	Yes	No	Yes	No	Yes

*Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

The results from the six-month period are similar. We estimate an increase by 0.18 per cent in the ILLIQ ratio for small- and mid-cap companies in Norway following MiFID II and the unbundling of research (Column 2). The coefficient on the turnover measure again indicate reduced liquidity and we estimate that the turnover of small- and mid-caps has been reduced by 0.05 per cent (Column 4). However, we note that this effect is not significant in the six-month period either. Also in the six-month period we find that the bid-ask spread for the small- and mid-cap stocks has increased, and we estimate that the spread widens by 1.02 per cent in

the period following the introduction of MiFID II (Column 6). This effect is again significant at a 0.1 per cent level.

Overall, the DDD-model shows clear signs of reduced liquidity of small- and mid-cap stocks in the period following the implementation of MiFID II. This result is valid both in the two- and six-month period. Additionally, both the estimated increase in the ILLIQ measure and the bid-ask spread are statistically significant at conventional levels.

6. Discussion – Has MiFID II affected liquidity?

In the following chapter we discuss the results from the empirical analysis and whether the results are both statistically and economically significant. Second, we outline how the regression results compare to our hypotheses and whether there is a relationship between analyst coverage and liquidity. Third, we discuss how the findings may be augmented in the coming years and the potential consequences. Lastly, we discuss the limitations and weaknesses of our paper and the empirical analysis.

6.1 Has MiFID II affected the number of analysts?

When evaluating the effect of MiFID II on analyst coverage of Norwegian stocks, our empirical analysis indicates that there has been a reduction of 0.08 – 0.11 per cent when including the full sample. Given the mean values (see Appendix A.3.1), a decrease of 0.08 – 0.11 per cent is equivalent to a reduction in the number of analysts of 0.7 – 0.9 analysts, in other words less than one analysts. This reduction represents less than 1/10 of a standard deviation, and can therefore be regarded as a relatively marginal change.

The triple difference model analysing the effect of MiFID II on small- and mid-caps also indicate a reduction in the number of analyst, and we estimate a decrease of approximately 0.04 per cent in the two- and six-month period. However, we note that the coefficients are not statistically significant. Given the mean value of in the sample including small- and mid-caps (Section 4.4.1) we find that this implies a reduction in the number of analysts of 0.2-0.3 analysts, equal to less than 1/13 of a standard deviation. As such, we cannot conclude that the effect is either statistically nor economically meaningful.

We do however note the negative coefficient, signifying a reduction in the number of analysts for small- and mid-caps relative to the US. This indicative trend is further supported by comments from representatives from the Norwegian buy- and sell-side industry. As part of our research, we surveyed industry representative ranging from portfolio managers, to compliance officers and heads of research from Norwegian banks, fund managers and brokerages. In our survey, six out of seven sell-side representatives responded that they had seen an overall reduction in the coverage of small-cap companies. The trend was similar for mid-cap companies, where four out of seven noted a reduction in research. Of the portfolio managers, 50 per cent had noticed a decline in the coverage of small-caps, whilst the effect was marginal

for mid-cap companies where only one portfolio manager commented that there had been a reduction. For large-cap companies, the heads of research and analysts surveyed were of the opinion that there had been no change in coverage, whilst two portfolio managers had experienced a decrease in research distributed. For additional details on the surveys and how the participants responded, please refer to Appendix A.4

We cannot conclude that MiFID II and research unbundling has caused a significant decrease in the coverage of small- and mid-cap stocks. Although we do not uncover a significant relationship between MiFID II and the reduction in the coverage of small- and mid-cap stocks in Norway relative to the US, we do highlight the negative trend and comments from industry practitioners on both buy- and sell-side who are noticing a reduction.

6.2 Has MiFID II affected liquidity?

Whilst the regression of the total sample gives an inconclusive result, we find that the triple-difference analysis clearly indicates a reduction in the liquidity of Norwegian small- and mid-cap stocks in the period following the implementation of MiFID II. Therefore, the following discussion will largely relate to the analysis on small- and mid-cap stocks in particular. In addition to the statistical significance of two of the liquidity measures, it is necessary to consider whether the results are economically meaningful, and if there has been a noticeable reduction in the liquidity level of relevant stocks.

First, when evaluating Amihud's illiquidity measure, we find a 0.23 and 0.18 per cent increase in ILLIQ for small- and mid-cap stocks, in the two- and six-month period, respectively. However, considering the standard deviation of the ILLIQ measure presented in the descriptive table in Section 4.4.2 we see that the sample of NOR stocks vary greatly in terms of the ILLIQ ratio. As such, an increase in the ratio of 0.23-0.18 per cent would only translate to an increase of 2.08-1.83 in the ILLIQ ratio based on the mean value which is less than 1/10 of a standard deviation. Hence, an increase of 0.23-0.18 per cent in the ILLIQ ratio of a stock that was considered relatively liquid before MiFID II would not result in the stock being considered illiquid. Thus, even if the effect is statistically significant we conclude that it cannot be interpreted as economically significant.

Second, for the bid-ask spread we estimate a statistically significant effect of a 0.99-1.02 per cent increase in the spread for small- and mid-cap companies in the period following MiFID

II, when considering the two- and six-month horizons, respectively. As the bid-ask spread relates to the transaction cost of trading and the aforementioned width dimension, increasing spreads could be indicative of increased transaction costs resulting in investors being reluctant to trade in the relevant instruments. Given the mean bid-ask spread for the small- and mid-cap stocks in the NOR sample of 95 and 97 bps (two- and six-month, respectively), and increase in the spread of 0.99-1.02 per cent would increase the spread by 1.3-1.5 standard deviations. Compared to the ILLIQ measure, we find this result to be of more economic importance and highlight that increased spreads could be damaging for further trading and future liquidity of small- and mid-cap stocks.

Lastly, the Turnover measure shows that the turnover decreases by 0.14 and 0.05 per cent in the two and six-month periods, respectively. Given a mean turnover of 0.01-0.27, this is also equal to less than 1/10 of a standard deviations and we cannot conclude that the results are of great economic relevance. As the estimated coefficients on the turnover measure are not significant we will not reflect further on the potential consequences of a marginal reduction in turnover.

The direction of the trend and statistical significance of the results in the triple-difference analysis give a clear indication of a negative liquidity effect for small- and mid-cap stocks following MiFID II. In addition, we find that the estimated increase in bid-ask spread of approximately 1.0 per cent is economically meaningful. Further, as the spread is indicative of the costs associated with trading and width dimension, we highlight that increasing spreads are likely to make it more difficult to trade in the relevant equities, reducing the attractiveness of the stocks.

In hypothesis 2a we suggest that MiFID II and the inducement rule would reduce analyst following of small- and mid-cap stocks, due to lower interest from institutional investors, which would cause liquidity of the relevant stocks to drop. The regression results presented above indicate that MiFID II has had a negative effect on liquidity of small- and mid-cap stocks. However, given the results outlined in Section 6.1, we cannot state that the observed effect is solely due to research unbundling and a reduction in analyst coverage.

6.3 Has liquidity decreased due to reduced analyst coverage?

As concluded in Section 6.2, we find that MiFID II has had a negative effect on the liquidity of Norwegian small- and mid-cap stocks relative to US stocks. However, the reason behind the reduction is not as clear. As outlined in Section 5.1 and 6.1, we cannot conclude that MiFID II has had a significant, negative effect on the analyst coverage of NOR small- and mid-caps relative to the US. We estimate a marginal, insignificant reduction of 0.04 per cent in the number of analysts following Norwegian small- and mid-caps. This decrease is lower than observed in the analysis including the whole sample. As such, it would be bold to state that *only* number of analysts has affected the liquidity of small- and mid-caps following MiFID II.

Another explanation may thus be that the observed reduction in liquidity is a consequence of other factors than research unbundling specifically, as MiFID II is a comprehensive directive covering several aspects of the market. One example is the requirement regarding reduced OTC and dark pool trading, moving the transactions onto regulated trading venues. As illiquid instruments and block sales are often traded through dark pools, restricted access to these venues could potentially reduce the level of trading and thus liquidity in the relevant stocks.

6.4 What will the future bring?

The empirical analysis of the effect of MIFID II on the number of analysts following small- and mid-cap stocks shows a marginal, insignificant effect. Further, the estimated coefficients in the analysis on liquidity are relatively small and of limited economic importance apart from the bid-ask spread. However, anecdotal evidence indicates that there might be some substantial changes over the coming years.

In our survey, five out of six respondents from the buy-side noted that they were likely to decrease the number of research providers over the next 1-3 years. This development is natural given the high cost of research, however it is also likely to increase the competition within the sell-side industry substantially. Increased competition for the “contracts” with the buy-side could further reduce the resources allocated towards small- and mid-cap companies.

As such, further adjustments from the buy-side in terms of budgets and the number of research providers, is expected to cause further adaptions on the sell-side in terms of analysts. Thus, the estimated decrease of number of research analysts is likely to continue over the next years.

with further reduction in the coverage of small- and mid-caps, which may amplify the effects estimated in Section 5 and reduce the liquidity of these stocks further.

Another effect we have not focused on in this paper are other consequences of reduced coverage. As mentioned in Section 2.3, losing coverage is expected to impact both performance and liquidity of a firm's stock. Mola et al. (2012) find that stocks that lose coverage for one year or more are 11 per cent more likely to delist within the next ten years than its covered peers. The stock market is an important institution and platform where corporations may raise funding. Hence, reduced coverage and liquidity following MiFID II could potentially lead to small- and mid-cap stocks losing direct access to capital markets.

Liquid markets gives enhanced efficiency through improved allocation of economic resources and information (Sarr and Lybek, 2002). However, we find that MiFID II has reduced the liquidity of small- and mid-cap stocks in the market. Increased competition amongst research providers over the coming years is likely to augment this effect, which we find to be contrary to ESMA's vision of improving the "functioning of the financial markets" by "making them more efficient […]".

6.5 Weaknesses and Limitations

The main limitation of our study is that there are no perfect control group. As outlined in Section 3.1 our preferred control group would be an EU country which has introduced all or most of the requirements in the directive apart from the new inducement rule regarding research unbundling. This would have allowed us to isolate the effect of research unbundling rather than estimating the effect of MiFID II and assuming that any changes are primarily due to research unbundling. MiFID II is a comprehensive directive designed to affect all asset classes and industry participants. As described in Section 2.1, MiFID II includes restrictions on dark pool trading, increased frequency of reporting, enhanced reporting standards and new guidelines on "best execution", in addition to the requirements regarding research unbundling. As such, the assumption that the liquidity of equities will foremost be affected by MiFID II through the new requirement on research unbundling is fairly bold. Although we estimate a slight reduction in research coverage, we do not find a significant relationship between MiFID II and analyst coverage when looking specifically on small- and mid-cap stocks. Thus, it is likely that MiFID II affects liquidity through different channels as well.

Although we have similar trends in the dependent variables before the implementation of MiFID II, there are several market-specific and macro-factors that could potentially affect the parallel trends in the period following the implementation of MiFID II. Our analysis however implicitly assumes that there are no other changes that occur in Norway nor the US through the relevant time period which may affect liquidity. As both individual stocks and the stock market are affected by a number of factors, including geopolitical tensions and the oil price for NOR stocks, that we have not controlled for this represents some concern as we cannot fully conclude that the observed difference in liquidity is solely due to MiFID II. We do however note that we have not registered other regulatory changes or changes to market practices through the relevant time period (Finansdepartement, 2019).

Lastly, the aftermath of MiFID II and the new requirements is still in an early phase. Several of the changes associated with MiFID II are of a structural character and there are likely to be further disruptions to both the sell- and buy-side over the coming years. In our analysis, we estimate the effect of MiFID II on liquidity by comparing two relatively short time-periods before and after the implementation. Although one can expect the liquidity of a stock to react promptly to changes, comments from market participants indicate that MiFID II will cause changes over a longer period. As noted earlier, 83 per cent of the respondents in our survey expect to reduce the number of research providers over the next 1-3 years. In addition, asset managers are likely to adjust their research budgets on an annual basis which could cause some lag in the full-effect. As such, further adjustment on the buy-side in terms of number of research providers and changes in the sell-side market in terms of number of analysts will potentially cause further reductions in the coverage of small- and mid-cap stocks, which may reduce the liquidity further. Arguably, MiFID II and research unbundling's effect on small- and mid-caps are still at an early stage and an analysis in two-three years may capture the incremental effects better.

7. Conclusion

The overarching aim of this paper has been to investigate if MiFID II and the research unbundling requirement has had an unintended, adverse effect on the liquidity of small- and mid-cap stocks. Through a comparative analysis of the liquidity of Norwegian stocks before and after the implementation, compared to the liquidity of US stocks we find that liquidity has indeed been affected.

MiFID II is one of the most thorough and comprehensive legislation in the European and financial markets in a decade. One of the key changes in the revised directive is the inducement rule which separates the cost of research and the execution fee. An anticipated consequence is that asset managers will reduce the number of research providers, which will cause research providers and analysts to focus on the companies that are of interest to institutional clients. Traditionally, these are large cap stocks with good liquidity, which implicitly results in reduced traction for small- and mid-cap stocks.

We therefore introduce two hypotheses; 1) MiFID II has had a negative effect on the number of analysts following Norwegian small- and mid-caps, and 2) MiFID II has negatively affected the liquidity of small- and mid-cap stocks due to reduced analyst coverage following the new research unbundling requirement.

To test the hypotheses, we use a portfolio of Norwegian stocks traded at the Oslo Stock Exchange as the treatment group. In order to construct a meaningful control group, we use propensity score matching, which allows us to pair our NOR stocks with US stocks with a similar statistical background. In our empirical study, we use the Difference-in-Difference method and a triple-difference analysis to isolate the effect of MIFID II on first the number of analysts and second three separate liquidity measures in the period post the implementation of MiFID II.

When investigating the effect of MiFID II on the number of analysts, we find a slight reduction of 0.08-0.11 per cent when evaluating the full sample. This effect is significant at a confidence level above 99%. However, when performing a triple difference analysis, focusing specifically on small- and mid-caps, we estimate a statistically insignificant, marginal reduction of 0.04 per cent in the number of analysts. As such, we are not able to disregard the alternative hypothesis (1b) that MiFID II has not had an effect on the analyst coverage of Norwegian small- and mid-caps.

However, when we corroborate the trend detected in the regression results with the observations of industry participants we do find it likely that there exists a relationship between MiFID II and the number of analysts following small- and mid-cap stocks in Norway. In our survey, 85 per cent of sell-side respondents indicated that there has been a reduction in coverage of small- and mid-caps following MiFID II, whilst 50 per cent of portfolio manager had seen the same trend.

In the analysis considering the effect of MiFID II on liquidity, the results on the total sample are rather inconclusive. However, the triple-difference analysis only considering the small- and mid-cap stocks show that we cannot reject hypothesis (2a). We find that the liquidity of small- and mid-cap stocks has been reduced in the period following MiFID II, with the three separate liquidity measures signifying a decrease. Of the statistically significant variables, we find that the ILLIQ ratio of the stocks in our portfolio has increased by ~0.2 per cent, which indicates increased illiquidity in the sample. However, the effect is of limited economic significance. We estimate that the bid-ask spread has increased by ~1.0 per cent equal to approximately 100 bps, which we consider to be of economic importance. Thus, there has on average been a meaningful increase in the bid-ask spread of small- and mid-cap stocks in our samples. As the bid-ask spread is related to the trading costs associated with the instrument, we believe this result is of high interest.

In sum, our empirical study shows that MiFID II has not had the anticipated negative effect on the number of research analysts following small- and mid-caps. Nevertheless, we do estimate a slightly negative trend indicating a reduction. We do however find that MiFID II has had a significant negative impact on the liquidity of small- and mid-cap stocks in the Norwegian market when compared to the US control sample.

We acknowledge that MiFID II is a structural change, and that it will take time before we see the full-effect of research unbundling with further adjustments to buy-side budgets and number of sell-side analysts going forward. We further note that there are likely other elements of MiFID II that have an affect on the liquidity of Norwegian small- and mid-cap stocks. Still, we believe that one of the key strength of this paper is that we have identified a reduction in the liquidity of small- and mid-cap stocks following MiFID II at an early point in time. As such, it should be of interest to both legislators and market participants to further monitor this effect, as the reduced liquidity of small- and mid-cap stocks is an unforeseen and unwanted consequence of the revised directive.

7.1 Possible Extensions and Further Research

As briefly mentioned above, we believe the market for research providers to be in the midst of a structural change, with further adjustments regarding the number of research providers and analysts going forward. We therefore believe it should be of interest for future studies to monitor the development in the liquidity level of small- and mid-cap stocks over a longer time-period. A natural extension of our study would therefore be to perform a similar study in 1-3 years when one has more data points, and clarity regarding the consequences. Another natural extension would be to investigate the effect in another EU country or the EU as a whole vs. the US or another control group.

MiFID II and research unbundling are as mentioned expected to change the market for research services profoundly. Another topic we briefly touched upon through our survey is how the sell-side has been adjusting so far and how the market is expected to change over the coming years. Increased competition may cause more consolidation which will reduce the overall number of research providers. Whilst some argue that this will make the market more efficient and enhance the value proposition of the remaining research products, others believe that a more consolidated market where the large corporations survive could endanger the originality of research products. All these considerations could be of interest for further studies.

As alluded to above, a reduction in the number of analysts is probably not the only explanatory factor for the observed reduction in liquidity of Norwegian small- and mid-cap stocks. Another interesting aspect would for example be to investigate how ESMA's double-cap on dark pool trading has affected liquidity of equities which previously mainly traded in these market.

References

Amihud, Yakov. 2002. “Illiquidity and Stock Returns: Cross-Section and Time-Series Effects.” *Journal of Financial Markets* 5(1): 31–56.

Amihud, Yakov, and Haim Mendelson. 1991. “Liquidity, Maturity and the Yields on U.S Treasury Securities.” *The Journal of Finance* 46(4): 1411–25.

Angrist, Joshua D, and Jorn-Steffen Pischke. 2009. *Mostly Harmless Econometrics : An Empiricist ’ s Companion Mostly Harmless Econometrics : An Empiricist’s Companion*.

Berck, Peter, and Sofia B. Villas-Boas. 2016. “A Note on the Triple Difference in Economic Models.” *Applied Economics Letters* 23(4): 239–42.

Brennan, Michael J., and Avanidhar Subrahmanyam. 1995. “Investment Analysis and Price Formation in Securities Markets.” *Journal of Financial Economics* 38(3): 361–81.

Brennan, Michael J., and Claudia Tamarowski. 2000. “Investor Relations, Liquidity, and Stock Prices.” *Journal of Applied Corporate Finance* 12(4): 26–37.

Brennan, Michael J, and Avanidhar Subrahmanyama. 1996. “Market Microstructure and Asset Pricing: On the Compensation for Illiquidity in Stock Returns.” *Journal of Financial Economics* 41(3): 441–64.

Brookhart, M. Alan et al. 2006. “Variable Selection for Propensity Score Models.” *American Journal of Epidemiology* 163(12): 1149–56.

Caliendo, Marco, and Sabine Kopeinig. 2008. “Some Practical Guidance for the Implementation of Propensity Score Matching.” *Journal of Economic Surveys* 22(1): 31–72.

Chollete, Lorán, Randi Næs, and Johannes A. Skjeltorp. 2007. *What Captures Liquidity Risk? A Comparison of Trade and Order Based Liquidity Factors*.

Chung, Kee H., Thomas H. McInish, Robert A. Wood, and Donald J. Wyhowski. 1995. “Production of Information, Information Asymmetry, and the Bid-Ask Spread: Empirical Evidence from Analysts’ Forecasts.” *Journal of Banking and Finance* 19(6): 1025–46.

Dick-Nielsen, Jens, Peter Feldhütter, and David Lando. 2011. “Corporate Bond Liquidity before and after the Onset of the Subprime Crisis.” *Journal of Financial Economics* 103(3): 471–92.

Easley, David, Maureen O’Hara, and Joseph Paperman. 1998. “Financial Analysts and Information-Based Trade.” *Journal of Financial Markets* 1(2): 175–201.

European Securities and Market Authority. 2018a. “MiFID II.” https://www.esma.europa.eu/policy-rules/mifid-ii-and-mifir.

European Securities and Market Authority. 2018b. Esma 35-43-349 *Questions and Answers On MiFID II and MiFIR Investor Protection and Intermediaries Topics*.

European Securities and Markets Authority. 2015. *Best Execution under MiFID - Peer Review Report*.

European Securities and Markets Authority. 2018c. "Guidelines Compliance Table." https://www.esma.europa.eu/sites/default/files/library/esma35-43-1215_compliance_table_on_joint_esma_and_eba_guidelines_eba_gl_2017_12_esma71-99-598.pdf.

European Securities and Markets Authority. 2019. "MIFID II." https://www.esma.europa.eu/policy-rules/mifid-ii-and-mifir.

Finansdepartement, Det kongelige. 2019. *Finansmarkedsmeldingen 2019*: 141.

Gabrielsen, Alexandros, Massimiliano Marzo, and Paolo Zagaglia. 2011. "Measuring Market Liquidity: An Introductory Survey." *Quaderni DSE Working Paper No. 802*

Gompers, Paul A., and Andrew Metrick. 2001. "Institutional Investors and Equity Prices." *Quarterly Journal of Economics* 116(1): 229–59.

Harris, Lawrence. 1990. "Liquidity, Trading Rules and Electronic Trading Systems." *New York University Salmon Center Monograph Series in Finance and Economics*.

Imbens, Guido W., and Jeff Wooldridge. 2008. "Recent Developments in the Econometrics of Program Evaluation." *IZA Discussion Paper No. 3640.*

Imbens, Guido, and Jeffrey Woolridge. 2007. "Difference-in-Difference Estimation." : 1–19. *Lecture 10 - What's new in Econometrics? NBER, Summer 2007.*

Jacobsen, Dag Ivar. 2005. *Hvordan Gjennomføre Undersøkelser? Innføring i Samfunnsvitenskapelig Metode*. Kristiansand: Høyskoleforlaget.

Lechner, Michael. 2010. *The Estimation of Causal Effects by Difference-in-Difference Methods*.

Lesmond, David A., Long Chen, and Jason Zhanshun Wei. 2007. "Corporate Yield Spreads and Bond Liquidity." *14th Annual Conference on Financial Economics and Accounting.*

Merton, Robert C. 1987. "A Simple Model of Capital Market Equilibrium with Incomplete Information." *The Journal of Finance* 42(3): 483–510.

Mola, Simona et al. 2012. "Is There Life after the Complete Loss of Analyst Coverage?" *The Accounting Review*.

Næs, Randi, J.A. Skjeltorp, and B.A. Ødegaard. 2008. "Liquidity at the Oslo Stock Exchange." *Working papers from Norges Bank* (9).

Rosenbaum, Paul R., and Donald B. Rubin. 1983. "The Central Role of the Propensity Score in Observational Studies For Causal Effects." *Biometrica* 70(1): 41–55.

Roulstone, Darron T. 2003. "Analyst Following and Market Liquidity." *Contemporary Accounting Research* 20(3): 551–78.

RSRCHXCHANGE. 2018. “Global Research Unbundling Survey - Summary Report June 2018.” (June 2018).

Sarr, A, and T Lybeck. 2002. IMF Working Paper *Measuring Liquidity and Financial Markets*. http://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0717-68212003012100045.

Saunders, Mark, Philip Lewis, and Adrian Thornhill. 2012. *Research Methods for Business Students*. 6th ed. Harlow, England: Pearson Education Limited.

SEC. 2017. “Press Release: SEC Announces Measures to Facilitate Cross-Border Implementation of the European Union ’ s MiFID II ’ s Research Provisions.” : 1–3. https://www.sec.gov/news/press-release/2017-200-0.

Selnes, Fred. 1999. *Markedsundersøkelser*. 4th ed. Oslo: Tano Aschehoug.

Turner, Michael, Christian Edelmann, James Davis, and Johan Blomkvist. 2017. *Research Unbundling*.

Wintermantel, Andrea, Amee Aujla, Fiona Lehane, and Elliot Hand. 2016. *The Future of Research - Impact of MiFID II on Research for Investment Firms*.

Appendices

A.1 Propensity Score Matching

The following is derived from Caliendo and Kopeinig (2008). Propensity score matching involves a binary treatment indicator D_i which is equal to 1 if observation i is subject to treatment, and 0 if the observation is not. In our analysis, D is an indicator of whether the stock is NOR or US, and thus if the relevant stock is subject to MiFID II. The outcome, in our case liquidity, is denoted by Y, where Y_i^1 is the outcome if observation i receives treatment and Y_i^o is the outcome if observation i is untreated.

We are interested in the comparing the differences in outcome Y_i^1 (liquidity if subject to MiFID II) with outcome Y_i^0 (liquidity if not subject to MiFID II). However, we can only observe one outcome for each observation i and we need to make an assumption of how the outcome would have been for a treated variable if not treated.

To compare the outcomes, the observed and the counter actual, one can estimate the average treatment effect on the treated (ATT),

$$\tau_{ATT} = E(\tau|D = 1) = E[Y^1|D = 1] - E[Y^0|D = 1]$$

where $E(Y^0|D = 1)$ is the unobserved, counter actual outcome. In order to get an estimate for for $E(Y^0|D = 1)$, we use a matching algorithm to construct a sample of untreated stocks $E(Y^0|D = 0)$ to substitute the unobserved outcome.

As of now, we assume that the NOR and US stocks only differ in observed characteristics. In other words, given the observed covariates x, the different outcomes are independent of being assigned to the treatment. This assumption is called the unconfoundness assumption and is formally given as

(1) $$Y^0, Y^1 \sqcup D|X.$$

This is a strong assumption, and we cannot be certain that we can observe and control for all x-characeristics associated with treatment.

The second assumption is the overlap assumption. This requires that observations with the same X values have a positive probability of being both NOR and US (treated and untreated).

(2) $$0 < P(D = 1|X) < 1$$

However, we can weaken both assumptions and only assume unconfoundedness for controls, as well as only weak overlap.

(3) $$Y^0 \sqcup D|X$$

(4) $$P(D = 1|X) < 1$$

The different observations are matched based on the propensity scores, defined as

$$p_i(x_i) = prob(D_i = 1|x_i)$$

where x_i is the observed characteristics for observation i. As such, the propensity score gives the probability of being a NOR stock and subject to MiFID II.

A.2 Matching quality – t-tests

A2.1 Pre-matching

Table 1 – T-test Propensity Score

ttest pscore, by (T)

Two-sample t-test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	1,470	0.0677	0.0001	0.0382	0.0658	0.0697
1	110	0.0922	0.0054	0.0571	0.0814	0.1029
Combined	1,580	0.0694	0.0010	0.0403	0.0674	0.0714
diff		-0.0244	0.0039		-0.0322	-0.0167

diff = mean(0) - mean(1) t = -6.2062

Ho: diff = 0 degrees of freedom = 1,578

Ha: diff < 0 Ha: diff !=0 Ha: diff > 0

Pr(T<t) = 0.0000 Pr(|T|>|t|) = 0.0000 Pr(T>t) = 1.0000

We can reject Ho of no statistical difference in the means

Table 2 – T-test Turnover by volume (shares traded)

ttest TO, by (T)

Two-sample t-test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	1,470	506.6	25.8	989.8	456.0	557.2
1	110	866.3	266.6	279.6	337.9	1,394.7
Combined	1,580	531.6	30.4	1,208.1	472.0	591.2
diff		-359.7	119.1		-593.4	-126.1

diff = mean(0) - mean(1) t = -3.0203

Ho: diff = 0 degrees of freedom = 1,578

Ha: diff < 0 Ha: diff !=0 Ha: diff > 0

Pr(T<t) = 0.0013 Pr(|T|>|t|) = 0.0026 Pr(T>t) = 0.9987

We can reject Ho of no statistical difference in the means

Table 3 – T-test Annualised 10-day volatility

ttest VO10D, by (T)

Two-sample t-test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	1,470	0.256	0.004	0.159	0.248	0.264
1	110	0.309	0.013	0.137	0.283	0.335
Combined	1,580	0.260	0.004	0.158	0.252	0.268
diff		-0.053	0.016		-0.084	-0.023

diff = mean(0) - mean(1) t = -3.4175

Ho: diff = 0 degrees of freedom = 1,578

Ha: diff < 0 Ha: diff !=0 Ha: diff > 0

Pr(T<t) = 0.0003 Pr(|T|>|t|) = 0.0006 Pr(T>t) = 0.9997

We can reject Ho of no statistical difference in the means

Table 4 – T-test Industry (GICS code)

ttest Industry by (T)

Two-sample t-test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	1,470	10.50	0.17	6.52	10.16	10.83
1	110	7.66	0.51	5.34	6.65	8.67
Combined	1,580	10.30	0.16	6.48	9.98	10.62
diff		2.83	0.64		1.58	4.08

diff = mean(0) - mean(1) t = 4.4464

Ho: diff = 0 degrees of freedom = 1,578

Ha: diff < 0 Ha: diff !=0 Ha: diff > 0

Pr(T<t) = 1.0000 Pr(|T|>|t|) = 0.0000 Pr(T>t) = 0.0000

We can reject Ho of no statistical difference in the means

Table 5 – Relative size (Quartile)

ttest Size, by (T)

Two-sample t-test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	1,470	2.50	0.03	1.12	2.44	2.56
1	110	2.50	0.11	1.11	2.29	2.71
Combined	1,580	2.50	0.28	1.12	2.44	2.55
diff		-0.0004	0.1106		-0.2172	0.2165

diff = mean(0) - mean(1) t = -0.0031

Ho: diff = 0 degrees of freedom = 1,578

Ha: diff < 0 Ha: diff !=0 Ha: diff > 0

Pr(T<t) = 0.4988 Pr(|T|>|t|) = 0.9975 Pr(T>t) = 0.5012

We cannot reject Ho of no statistical difference in the means

A.2.2 Post-matching

Table 6 – T-test Propensity score

ttest pscore, by (T)

Two-sample t-test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	110	0.0957	0.0081	0.0847	0.0797	0.1117
1	110	0.0922	0.0055	0.0571	0.0814	0.1029
Combined	220	0.0939	0.0049	0.0721	0.0844	0.1035
diff		0.0036	0.0097		-0.0156	0.0228

diff = mean(0) - mean(1) t = 0.3668

Ho: diff = 0 degrees of freedom = 218

Ha: diff < 0 Ha: diff !=0 Ha: diff > 0

Pr(T<t) = 0.6429 Pr(|T|>|t|) = 0.7142 Pr(T>t) = 0.3571

We cannot reject Ho of no statistical difference in the means

Table 7 – T-test Turnover by volume (shares traded)

ttest TO, by (T)

Two-sample t-test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	110	992.2	212.4	2,227.9	571.2	1,413.2
1	110	866.3	266.6	2,796.5	337.9	1,394.7
Combined	220	929.3	170.1	2,523.2	594.0	1,264.5
diff		125.9	340.9		-546.0	797.8

diff = mean(0) - mean(1) t = 0.3693

Ho: diff = 0 degrees of freedom = 218

Ha: diff < 0 Ha: diff !=0 Ha: diff > 0

Pr(T<t) = 0.6439 Pr(|T|>|t|) = 0.7123 Pr(T>t) = 0.3561

We cannot reject Ho of no statistical difference in the means

Table 8 – T-test Annualised 10-day volatility

ttest VO10D, by (T)

Two-sample t-test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	110	0.319	0.041	0.432	0.237	0.400
1	110	0.309	0.013	0.137	0.283	0.335
Combined	220	0.314	0.022	0.220	0.272	0.356
diff		0.010	0.043		-0.076	0.095

diff = mean(0) - mean(1) t = 0.2216

Ho: diff = 0 degrees of freedom = 218

Ha: diff < 0 Ha: diff !=0 Ha: diff > 0

Pr(T<t) = 0.5876 Pr(|T|>|t|) = 0.8249 Pr(T>t) = 0.4124

We cannot reject Ho of no statistical difference in the means

Table 9 – T-test Industry (GICS code)

ttest Industry, by (T)

Two-sample t-test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	110	7.80	0.53	5.59	6.74	8.86
1	110	7.66	0.51	5.34	6.66	8.67
Combined	220	7.73	0.37	5.45	7.01	8.46
diff		0.14	0.74		-1.32	1.59

diff = mean(0) - mean(1) t = 0.1851

Ho: diff = 0 degrees of freedom = 218

Ha: diff < 0 Ha: diff !=0 Ha: diff > 0

Pr(T<t) = 0.5733 Pr(|T|>|t|) = 0.8533 Pr(T>t) = 0.4267

We cannot reject Ho of no statistical difference in the means

Table 10 – T-test Relative size (Quartile)

ttest Size, by (T)

Two-sample t-test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	110	2.61	0.10	1.06	2.41	2.81
1	110	2.50	0.11	1.11	2.29	2.71
Combined	220	2.55	0.07	1.09	2.41	2.70
diff		0.109	0.147		-0.180	0.398

diff = mean(0) - mean(1) t = 0.7441

Ho: diff = 0 degrees of freedom = 218

Ha: diff < 0 Ha: diff !=0 Ha: diff > 0

Pr(T<t) = 0.7712 Pr(|T|>|t|) = 0.4576 Pr(T>t) = 0.2288

We cannot reject Ho of no statistical difference in the means

A.3 Descriptive statistics – Full sample

A.3.1 Analysts – Full sample

Table 11.1 – Descriptive statistics, 2-month period pre-MiFID II

	2-months (PRE-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Analysts	8.12	6.93	1.00	38.00	15.08	10.16	1.00	38.00
MarketCap	2,492.0	7,848.3	6.1	68,101.1	21,745.1	61,859.9	139.0	487,236.9
Volume Traded	0.96	2.98	0.00	29.37	1.08	2.46	0.03	17.55

**Market cap (USDm) and Volume traded (m)*

Table 11.2 – Descriptive statistics, 2-month period post-MiFID II

	2-months (POST-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Analysts	7.79	6.78	1.00	36.00	15.13	10.19	1.00	39.00
MarketCap	2,671.3	8,605.5	6.4	76,934.7	2,2184.7	64,533.7	190.9	502,008.3
Volume Traded	1.07	4.09	0.00	43.40	1.40	3.31	0.03	21.79

**Market cap (USDm) and Volume traded (m)*

Table 11.3 – Descriptive statistics, 6-month period pre-MiFID II

	6-months (PRE-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Analysts	8.20	7.13	1.00	40.00	15.18	10.27	1.00	39.00
MarketCap	2,441.1	7,521.0	5.8	68,101.1	21,282.0	59,840.8	114.1	487,236.9
Volume Traded	0.91	3.10	0.00	33.71	1.02	2.29	0.02	17.55

**Market cap (USDm) and Volume traded (m)*

Table 11.4– Descriptive statistics, 6-month period post-MiFID II

	6-months (POST-MiFID II)							
	Norway				US			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Analysts	7.34	6.48	1.00	36.00	15.01	10.16	1.00	39.00
MarketCap	2,737.7	9,103.5	6.2	88,496.2	21,870.0	62,324.7	140.6	502,008.3
Volume Traded	0.97	3.51	0.00	43.40	1.22	2.90	0.02	21.79

**Market cap (USDm) and Volume traded (m)*

A.3.2 Liquidity – Full sample

Table 12.1 – Descriptive statistics, 2-month period pre-MiFID II

	PRE-MiFID II (2-month)							
	Norway (N:110)				US (N:110)			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Amihud ILLIQ	6.96	20.14	0.001	118.23	0.11	0.14	0.001	0.89
Turnover	0.096	0.109	0.001	0.523	0.132	0.113	0.037	0.738
Relative Bid-Ask Spread (bps)	77.9	68.6	7.9	524.3	9.0	22.8	0.8	227.5
Market Cap	2,493.5	7,865.8	6.1	67,664.0	21,735.7	61,913.5	149.0	471,500.1
Volume Traded	0.96	2.88	0.00	23.36	1.07	2.45	0.03	15.73
Ann. 10D Volatiliy	34.1	16.7	12.5	103.1	32.7	21.6	10.1	148.8

**Market cap (USDm), Shares outstanding (m), Volume traded (m) and Annualised 10-day volatility (%)*

Table 12.2 – Descriptive statistics, 2-month period post-MiFID II

	POST-MiFID II (2-month)							
	Norway (N:110)				US (N:110)			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Amihud ILLIQ	9.48	30.54	0.001	214.07	0.11	0.13	0.001	0.62
Turnover	0.094	0.112	0.001	0.630	0.147	0.112	0.033	0.547
Relative Bid-Ask Spread (bps)	77.5	77.4	5.0	446.3	7.2	9.6	1.2	54.0
Market Cap	2,671.3	8,624.2	6.4	76,128.1	22,180.9	64,645.2	198.2	501,273.9
Volume Traded	1.07	4.06	0.00	39.69	1.40	3.29	0.03	20.52
Ann. 10D Volatiliy	34.5	16.0	12.5	113.2	35.5	14.7	18.1	91.0

**Market cap (USDm), Shares outstanding (m), Volume traded (m) and Annualised 10-day volatility (%)*

Table 12.3 – Descriptive statistics, 6-month period pre-MiFID II

	PRE-MiFID II (6-month)							
	Norway (N:110)				US (N:110)			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Amihud ILLIQ	7.65	20.09	0.001	98.61	0.11	0.14	0.001	0.81
Turnover	0.266	0.337	0.007	1.930	0.383	0.293	0.089	1.516
Relative Bid-Ask Spread (bps)	79.3	65.4	8.1	447.3	9.3	23.6	0.9	235.7
Market Cap	2,441.0	7,531.0	6.2	63,988.7	21,268.7	59,880.0	137.5	452,228.9
Volume Traded	0.90	2.99	0.00	26.37	1.02	2.24	0.03	14.63
Ann. 10D Volatiliy	30.9	13.7	13.6	97.5	29.3	19.1	10.2	172.9

**Market cap (USDm), Shares outstanding (m), Volume traded (m) and Annualised 10-day volatility (%)*

Table 12.4 – Descriptive statistics, 6-month period post-MiFID II

	POST-MiFID II (6-month)							
	Norway (N:110)				US (N:110)			
Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Amihud ILLIQ	11.58	39.23	0.001	310.16	0.11	0.12	0.00	0.56
Turnover	0.289	0.320	0.005	1.993	0.413	0.301	0.083	1.576
Relative Bid-Ask Spread (bps)	82.1	94.5	6.2	727.1	7.0	9.2	1.2	47.2
Market Cap	2,738.52	9,125.7	6.7	83,547.2	21,862.6	62,474.7	186.5	487,468.7
Volume Traded	0.97	3.40	0.00	33.32	1.22	2.85	0.03	16.99
Ann. 10D Volatiliy	36.3	16.5	17.3	120.5	31.0	12.5	17.0	78.7

**Market cap (USDm), Shares outstanding (m), Volume traded (m) and Annualised 10-day volatility (%)*

A.4 Qualitative study – Results from buy-/sell-side survey

As part of our research, we interviewed a handful of MiFID II experts in the Nordic region and surveyed buy- and sell-side participants in Norway to gain a broader understanding of the impacts of MiFID II. In-line with Selnes (1999) we find that that qualitative methodology can increase insights and enhance understanding of a topic.

In the survey, we designed a separate survey for sell- and buy-side, where the first target respondents were Head of Research or Head of Compliance, and the latter was Portfolio or Asset Managers. Due to the sensitive nature of the survey, we enabled the anonymity settings, so that we could neither track distributed links nor IP-addresses. By guaranteeing that all data and responses are collected anonymously, this may contribute to increasing the response rate (Jacobsen, 2005). The survey comprised a combination of multiple choice, with the possibility to add comments, and full-text answer questions. This design was opted for as we wanted a clear indication of the direction of events (e.g. "increase, unchanged, decrease" options), as well as the respondents' thoughts and comments about the changes so far and how the market will develop.

Before the survey was distributed, we conducted a pilot survey that was sent out to some contacts we had on the buy- and sell-side in order to validate the formulation and questions in the surveys. Saunders, Lewis and Thornhill (2012) explains the importance of conducting a pilot survey to test if the collection of data is trustworthy and that the survey measures what it is supposed to, in addition to making sure that the survey works. The responses from the pilot survey gave valuable feedback, that helped to secure the quality of the final survey. Nevertheless, there are some limitations with the use of surveys. There are limited opportunities for follow-up questions, or to clarify misunderstandings during the process (Saunders, Lewis, and Thornhill, 2012). However, given our time constraint and our desire to reach out to as many participants as viable, we decided that an online survey was the best option.

In total we reached out to 13 investment firms and 13 brokerage firms/banks. We received seven responses from the sell-side and six on the buy-side, indicating a response rate of 54 and 46 per cent, respectively. Please see the tables below for a summary fo the survey and aggregated responses.

A.4.1 Sell-side survey

Design of research subscription	One price full access			levels depending access	
	0			7	
	10% higher	5-9% higher	Same range	5-9% lower	10% lower
Pricing compared to competitors	0	1	4	2	0

Effect on revenues:	Positively	Unchanged	Negatively
research unbundling affect revenues in 2018?	1	0	4
Research unbundling affect revenues next 1-3y?	1	0	4
Changes in overall market:	Increase	Unchanged	Reduced
Number of analysts	0	3	4
Analyses per analyst	2	5	0
Number of companies under coverage	2	1	4
Quality of research	0	6	1
Coverage of large-cap	1	6	0
Coverage of mid-cap	1	2	4
Coverage of small-cap	0	1	6
Changes in *your* firm	Increase	Unchanged	Reduced
Number of analysts	0	5	2
Analyses per analyst	3	4	0
Number of companies under coverage	1	5	1
Quality of research	0	7	0
Coverage of large-cap	0	7	0
Coverage of mid-cap	1	2	4
Coverage of small-cap	0	1	6
Change in demand research analyst	1	0	6

	Yes	No
Contacted by comp. regarding sponsored research	1	6
Increased consolidation sell side	6	1

	Publish more	Unchanged	Publish less
Change in composition of analysis	4	7	0

Disadvantages of MiFID II:

"*Destroying a well-functioning alignment of interest (=good research = commission). Favours big banks willing to take large upfront investments to squeeze out competition. Unbundling of research and execution effectively means research is becoming more dependent on investment banking revenues. As a result,* ***many small/midcaps will lose coverage****."*

"*A lot of administration. There will be* ***fewer analysts****, which potentially could mean weaker coverage and* ***poorer coverage*** *of some companies. this could again raise the cost of capital."*

"Less competition, more "corporate focused" analyst in the independent investment banks"

How will MiFID II affect the sell-side?:

"Juniorisation, investors will rely more on in-house research, with less economies of scale. ***Less coverage of small caps****. Investment banking clients paying proper fees will get better quality and service, leading to unwanted "bundling", i.e. research becoming less independent."*

Consolidation:

"Less analysts needed, but still room for quality and in-depth analyses."

A.4.2 Buy-side Survey

	Asset Manager	Private Bank	Pension Fund
Kind of firm:	5	1	0
	RPA	P&L	Combination
Payment method	0	6	0

	Increase >10%	Increase <10%	Unchanged	Decrease <10%	Decrease >10%
Budget expected changes 2019 and forwards	0	1	3	0	2

	Positive	Unchanged	Negative
Net effect MiFID II on margins	0	3	3
How will consumption on the following change:	Increase	Unchanged	Decrease
Tier 1	2	4	0
Mid/ regional banks	0	3	3
Brokers	3	2	1
Independent providers	1	4	1
Overall	0	4	2
In house analysts:	Increase	Unchanged	Decrease
Change so far	3	3	0
Change going forward	2	4	0
	Significant degree	Somewhat affected	No material change
Degree MiFID II has affected research consumption	0	4	2
	Increase	Unchanged	Decrease
Change in number of research providers 1-3y forward	0	1	5

	Significantly Improved	Somewhat improved	Unchanged	Somewhat worsened	Significantly worsened
Changes in quality of provided research	0	0	2	4	0
Changes in quantity of provided research	Significantly more	Somewhat more	Unchanged	Somewhat less	Significantly less
	0	0	0	6	0

Changes in coverage of:	Increase	Unchanged	Decrease
National	0	3	3
International	0	5	1
Foreign	0	4	2
Large-cap	1	3	2
Mid-cap	0	5	1
Small-cap	0	3	3

Disadvantages of MiFID II:

"Losing access to research from brokers you no longer have a relationship to"

"The vast amount of reporting. Potential for greater costs, which in the end hurts the end client."

"With respect to research payment, less willingness to conduct company research on small-cap companies"

"It benefits the big asset managers and squeezes out the smaller ones"

How MiFID II affects relationship between buy side and sell side:

"Closer relationships with fewer counterparties"

"More formal. Diversification in service depending on payment"

How MiFID II will affect buy side:

"More disciplined research spending. Increase in in-house research"

"Falling quality of research. Overall negative"

"A cost increase for us, less access to research from brokerages"