The effect of the European Market Abuse Regulation on market efficiency and market quality

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Abstract

This study investigates the effect of the Market Abuse Regulation (MAR) on liquidity and short-term volatility. MAR aims to increase market efficiency and integrity by tightening existing regulations and extending the scope of market abuse legislation to previously unregulated venues like multilateral trading facilities. The focus of the research model lies on difference-in-differences regressions, executed for different levels of market capitalisation, comparing the effects of the law on a newly regulated MTF to those on an already regulated exchange. We find that MAR has an increasing effect on liquidity for small- and mid-capitalisation stocks, while also increasing transitory volatility.

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1. Introduction

On the 3rd of July 2016, the so called "Market Abuse Regulation" (EU regulation no 596/2014, hereinafter "MAR") was implemented into national law in the member states of the European Union, thereby replacing the previous regulatory framework on insider trading and market abuse, the "Market Abuse Directive" (Directive 2003/6/EC). Similarly to its predecessor, the regulation forbids a person in possession of private information, that, if disclosed publicly, would have a significant effect on the price of a financial instrument, from trading in that instrument (insider trading). It also outlaws conveying the insider information to a third party with the purpose of influencing their trading decision. The new legislation is intended to ensure market integrity, which is defined as the absence of market abuse and linked closely to market efficiency in the text of the law, uniformly and more tightly across member states, as well as adapt to the structural changes brought forth by the advance of trading technology.

Aside from content-related differences, the two regulatory frameworks are also set apart in their legal implications. An EU directive, as was previously employed, establishes targets and guidelines, but gives the member states a certain freedom in how they implement them into their national law. A regulation, in contrast, is legally binding for every country in the European Union (europa.eu).

A structural change, named in the regulation as one of the reasons for the adjustment of the legal framework, has been the emergence of multilateral trading facilities (MTFs) and organised trading facilities (OTFs), which had not been subject to the same rigor of market abuse prevention as regulated exchanges prior to the introduction of MAR. This tightening of the regulatory framework and especially its extension to a wider array of trading venues constitute a unique opportunity for quantitative evaluation.

While there has been extensive research on insider trading, its regulation, and the effect it has on factors of microstructure and market quality (Cumming et al., 2011; Chen et al., 2017), there have been only few recent studies (Prevoo and Ter Weel, 2010; Collver, 2007; Brochet, 2010), especially on European markets, focussing on the implications of regulations, aiming at a more universal prohibition of market abuse. We seek to address this gap by studying the effects the MAR has on measures of market quality and market efficiency in Sweden. The goal of this study is to assess the success of MAR in achieving its self-proclaimed goal of ensuring market efficiency.

Two aspects of market efficiency of particular scientific interest with regard to the effects of market abuse and the regulation thereof are liquidity and volatility. The models of informed trading by Kyle (1985) and Glosten and Milgrom (1985) suggest that in response to an increased occurrence of insider trading, market makers would increase spreads. Amongst others, Khan et al (2005) find empirical evidence for this modelled behaviour by identifying a positive correlation between instances of insider trading and the bid-ask spread. Du and Wei (2003) find a significant relationship between the frequency of insider trading and market volatility. Similar patterns are found in regard to market manipulation (for the positive correlation between manipulation and spreads for example Aitken et al., 2015; for volatility Chiou et al., 2007).

Cumming et al. (2011) compare market abuse regulation regimes across countries and trading venues and find that stricter regulatory frameworks lead to less volatile and more liquid markets.

A relevant issue with regard to the effect of MAR on market efficiency, is the impact of insider trading on price discovery. As Glosten and Milgrom (1985) describe, market makers are able to derive information about the true value of a security by trading with insiders and, thus, can adjust their prices accordingly. An accelerated price discovery process due to insider trading is found empirically by Meulbroek (1992), Cornell and Sirri (1992), and Chakravarty and McConnell (1997). Foucault et al. (2013) conclude that this dynamic constitutes a dilemma for lawmakers, as more tightly regulated insider trading seems to facilitate liquidity while inhibiting rapid price discovery.

The relationship between insider trading, liquidity, and price discovery has implications for MAR, as its goal of ensuring market efficiency is directly affected by this trade-off.

We contribute to the existing literature, by analysing the changes, brought forth by a specific, recent piece of market abuse legislation in the European Union on market efficiency, specifically addressing the mentioned trade-off.

Using panel data from a regulated exchange and an MTF, we assess if the effects, found in the literature to be associated with market abuse legislation, can be measured for the implementation of MAR by executing difference-in-differences regressions. We focus on the quoted spread as a measure of liquidity and utilize variance ratios to identify transitory volatility, constituting short-term pricing inefficiencies. We find a significant decrease of bid-ask spreads after the implementation of MAR. The estimates we obtain for the transitory volatility show an increase following the implementation of MAR, suggesting a decrease in efficiency.

2. Literature Overview

To thoroughly analyse the effects brought forth by MAR, the specific practices, deemed illegal by the law, have to be investigated for their potential impact on the market. The categories of illegal trading behaviours laid out in the piece of legislation are unlawful insider trading, disclosure of inside information, conducting of unlawful market soundings, and market manipulation. The focus of this examination lies on insider trading and market manipulation.

We exclude a specific investigation of unlawful information disclosure as its effects on the market are indistinguishable from insider trading. An uninformed party receiving specific, private information is elevated to the status of an insider and acts as such, until the piece of information becomes public. Similarly, we exclude the conducting of market soundings from our research. Market soundings are events occurring outside the marketplace, the market effect of which would only be measurable in conjunction with particular prosecuted cases, which makes them unsuited for our objective.

Reviewing the literature on market manipulation and insider trading will give an overview of the quantifiable symptoms, exhibited by markets that are exposed to such unlawful practices. To measure the effectiveness of MAR in achieving its proclaimed goal, market integrity, we have to define what that concept entails and investigate in what ways the forbidden practices would impede it.

2.1 Insider Trading

For a deeper investigation of the topic, a distinction has to be made between legal and illegal insider trading. The main legislative determinant of the two is the nature of the private information. If it is precise and would have a significant price effect upon public disclosure, an insider, trading in the instrument related to this information, would behave unlawfully (EU regulation no 596/2014). The issuing venues have to keep lists of insiders (including officers, directors, and major shareholders), and submit them to the legislative body. An insider can engage in legal trade in the stock of the company he is associated with, if he does not possess information of the nature described above. He, however, has to report his transaction within a certain time period to the responsible regulatory entity. The MAR imposes stricter sanctions on illegal insider trading and tightens the guidelines and timeframe for reporting legal insider transactions.

The distinction between legal and illegal behaviour might be much harder in practice, as insider information in the sense of the law is hard to distinguish. In both cases, an insider will have a more informed perception, even if imprecise, of the value of an instrument, compared to an outsider (Lakonishok and Lee, 2001).

The effects of the presence of informed investors in a market have been prominently modelled by Glosten and Milgrom (1985) and Kyle (1985). In both papers, the authors assess that specialists, acting as counterparties to traders in the market, incur losses when trading with informed investors. These losses are mitigated by an increase in transaction costs, measured via the bid-ask spread, so that the specialist gains a profit of zero in equilibrium. The increased costs are covered by uninformed investors, as they do not possess information about the true value of a security and a potential over- or undervaluation. As the transactions have informative content, private information is implemented into market prices over time, reducing the magnitude of the spread and yielding an efficient market in the long term. That means, that before an equilibrium is reached, insiders realise abnormal returns to the detriment of uninformed investors.

An informed investor in the sense of these papers can be an insider, illegally trading on private information, as defined in MAR. Company executives and analysts, who trade based on superior understanding of a firm or on superior analysis, without being in possession of specific private information, would however be considered informed investors as well.

The conclusion that insider trading, legal and illegal, decreases liquidity is backed by a large body of research (Cheng et al. (2006); Gu and Li (2004); etc.). A positive contribution to price discovery is found by Meulbroek (1992), Cornell and Sirri (1992), and others. Foucault et al. (2013) substantiate this correlation between the frequency of insider trading and price discovery in the context of the model of Glosten and Milgrom (1985).

A comparative approach with focus on the volatility-effect of insider trading between countries is taken by Du and Wei (2004). They account for different underlying factors for volatility like the volatility of the macroeconomic output and the maturity of the asset market across observations as well as factors like the rigor of insider trading prosecution. The authors find that insider trading indeed correlates with market volatility and that its effect is stronger than for other fundamentals.

These findings constitute a dilemma for lawmakers, as there seems to be a trade-off between fundamental aspects of financial markets, some of which are affected beneficially and some detrimentally by insider trading and the regulation thereof. Leland (1992) investigates this

trade-off and finds that insider trading has a negative effect on public welfare in situations, where the investment flexibility decreases, the risk aversion increases, liquidity trading is more volatile, or the future price volatility increases. As a counterpoint, the author concludes, that the effect of insider trading is positive, if the price sensitivity of an investment is high.

The influence of regulation on insider trading and its effects has been researched in the past. Huddart et al. (2001) extend Kyle's model with the requirement that insiders have to publicly disclose their transactions ex post (which is in line with the requirements on the Swedish market, albeit already more loosely in place before MAR). They assess that the public disclosure halves insiders' abnormal returns, as they try to obscure the informational content of their transactions by also performing trades contrary to their information.

Brochet (2010) analyses the effect of the Sarbanes-Oxley Act of 2002 in the USA. The law tightened the timeframe for public disclosure of insider transactions, much like the MAR although to a larger degree. He finds that such an increase in reporting timeliness seems to lead to increased abnormal trading volumes around filing days, but no increase in aggregate volatility.

The relationship between strict market abuse legislation and liquidity is further substantiated by Cumming et al. (2011). The authors compare the regulatory framework and performance of 42 exchanges around the world and come to the conclusion that detailed and tight rules against market abuse are negatively correlated with bid-ask-spreads. In this study, we evaluate if these results hold true for the introduction of the European MAR on the Swedish market, by assessing its effect on liquidity, volatility, and price discovery.

It is to note here, that the European MAR also outlaws the disclosure of inside information. This part of the law however is not relevant to our analysis, as the receiver of unlawful information simply ascends to the status of an informed/insider trader and will act as such in the market to the same effect. The nature of the offense might therefore be interesting from a legal standpoint but is quantitatively indistinguishable from insider trading.

2.2 Market Manipulation

The concept of market manipulation differs from that of insider trading and the dispersion of insider information in terms of scope and ease of measurement. While the latter two require the offender to be in possession of superior information compared to the rest of the market, this is not the case for market manipulation (although the manipulator knows of his own dispersal of misinformation, while other market participants do not).

In the MAR, a multitude of practices fall under the definition of market manipulation, including entering into transactions that likely give false or misleading signals as to supply, demand, or price of a security, entering into transactions that fixate security prices at an artificial level, and employing deception or disseminating false information to achieve the aforementioned goals. These examples represent trading behaviours, that potentially yield profits by unethical (and recently unlawful) means, that specifically do not require an investor to be informed.

The analysis of market manipulation and its distinction into categories has long been subject of research. Allen and Gale (1992) who take a historical outlook on price manipulation and its regulation, identify three categories of such practices. The first category is defined as action-based manipulation. To give a historical example, the authors lead by describing "bear raids" in the first half of the 20th century, where investors would short sell large amounts of stocks to severely decrease the price of the stock to an artificial level. Members of the New York council conspired to perform such a raid on the successful stock of a railway company and repeal a beneficial ordinance for the company, further driving the price down. When the leader of that company discovered the plot, he secretly bought back all of the "raided" stock, resulting in a settlement with large losses for the conspirators. As the example illustrates, action-based manipulation requires an action, other than a transaction itself, to affect the price and the perception of supply or demand of a security.

The second category defined by Allen and Gale (1992) is that of information-based manipulation. In line with the MAR, the dispersion of false or misleading information constitutes this type of manipulation.

The last category, the authors call trade-based manipulation. A potential manipulator in this case trades without inside information and the spreading of misleading information but attempts to use the price impact of his order to sell the same security at a higher price. In the sense of the law, this behaviour would constitute an unlawful signal as to the demand of a security. From an efficient market perspective, it seems counterintuitive that such a manipulative transaction could be profitable. Buying a security increases the price and the attempt to sell it drives the price down, seemingly yielding no profit. The authors however model such a situation and find the manipulation to be profitable, because uninformed traders cannot distinguish an informed order from a manipulative order, therefore deriving information from the price increase, that the security might be undervalued.

A different point, with the same conclusion, is raised by Allen and Gorton (1991). They criticise the models of informed trading by Glosten and Milgrom (1985) and Kyle (1985) for their

assumptions of symmetry in the likelihood of sellers and buyers being informed and the likelihood of liquidity traders entering into a buying or selling position. The authors point out that short sale constraints make it more likely for a buyer to be informed, as they make it easier to profit from good news than bad. On the other side of the spectrum, it seems imaginable that liquidity traders are forced into a selling position, but much less into a buying position. The timing of the latter can be chosen more freely, as there rarely is an imminent need for a trader to own a stock compared to an imminent need for cash. An uninformed trader would then likely time his purchase to minimize the risk of an informed trader profiting from the transaction, by trading after positive announcements. The authors introduce these asymmetries to the existing models and find trade-based manipulation to be profitable and challenging to deal with by market makers.

As manipulators and informed traders only differ in their intention and their possession of actual information, which can only be measured indirectly, a detection of trade-based manipulation is challenging. In an empirical setting, a potential manipulation attempt, compared to an informed trade, could cause a quicker mean reversion of the price, which would lead to increased short-term volatility in a market where a manipulator is present.

Aggarwal and Wu (2006) expand on the model of Allen and Gale (1992). They assume that there are "information seekers", trying to derive information about a stock's underlying value. In general, the presence of such information seekers would benefit market efficiency, while the presence of manipulators would reduce it. The authors find however, that the presence of both in the same market leads to the previously described effect, decreasing market efficiency and the opportunity for arbitrage, while increasing volatility and profitability of manipulation. Analysing reported instances of market manipulation in the US between 1990 and 2001, the authors come to several conclusions related to the properties of markets, in which manipulation is more common, as well as the symptoms exhibited by such markets. Manipulation seems to be more frequent in small and illiquid markets, where regulation is less strict.

These characteristics are consistent with the MTF, analysed in this study, which reinforces the sentiment, that manipulation could have been more common there than on the primary market prior to the introduction of MAR.

Comparing manipulated stocks with a matched sample of non-manipulated ones, Aggarwal and Wu (2006) observe, that manipulated stocks are less liquid than their matched counterpart. During the manipulation period, however, liquidity as well as return and volatility are higher for the manipulated sample. Due to short-selling constraints, manipulation attempts appear to occur

more frequently towards an upward direction of the price. The price seems to increase throughout the manipulation period and falls subsequently, when the manipulation has ended. At the time of sale by the manipulator, the price is higher, the higher liquidity or volatility are, confirming the modelled assumption, that the presence of information seekers in the market, which correlates with uncertainty about the stock's value, increases manipulation profitability. Investigating the symptomatic patterns, described in the mentioned papers, will enable an assessment of manipulation frequency in the Swedish sample before and after the introduction of MAR.

In the aforementioned papers, the relevance of regulation is explicitly expressed. Allen and Gale (1992) describe the risk of action-based and information-based manipulation to be largely eliminated in the US, due to the introduction and adjustment of market abuse legislation, one of the earliest of them the Securities Exchange Act 1934. The severe increase of market participants and trading volume as well as the emergence of the internet and computer-based trading technologies however, hinder the efficiency of outdated trading regulation. The anonymity and speed of information dissemination through the internet, for example, makes information-based manipulation more profitable and easier to disguise.

Van Bommel (2003) extends Kyle's (1985) model of informed trading and shows that an informed trader has the opportunity to profit twice from the received information. The author assumes that trading on the information itself only has a marginal price impact and the informed trader remains superiorly informed after his trade. He can then spread imprecise rumours to fellow traders, either false or correct, to achieve an overshooting/ overcorrecting effect on the price, on which he can trade profitably for the second time. Both manipulators and informed traders achieve abnormal returns in this situation, to the detriment of noise traders. Similar to a potentially positive effect on price discovery from informed trading, there can be valuable informational content in rumours.

In the case of false rumours, information is revealed about the trustworthiness of the source and enables prosecution in case of bad intent. A specific type of "rumourmongering", called "bluffing" by Van Bommel (2003) is further investigated by Chakraborty and Yilmaz (2004). In their model, informed traders profit abnormally by first incurring small losses in the short term due to trading against their information. This behaviour increases noise and volatility in the market, which results in a higher return for the informed investor when trading in line with their information.

A proclaimed goal of MAR is the inhibition of the described practices of market manipulation, as well as overcoming the challenges brought forth by the emergence of new technology. We

expect markets, where manipulators are present, to behave according to the patterns elaborated on in the previous research, which should enable us to identify a potential change in the frequency of such patterns after the implementation of MAR.

2.3 Interdependence of insider trading and market manipulation

An important point for clarification before conducting the quantitative analysis is that of the interdependencies between insider trading and market manipulation.

As it was pointed out in the previous chapters, certain manipulative practices can be misconstrued as the actions of an informed investor and insiders might be inclined to manipulate the market to gain an additional profit from their private information. In both cases, the lines between insider trading and market manipulation blur.

Khan et al. (2005) find, that market makers are relatively unable to adjust spreads in direct response to incidents of insider trading but will recover their losses from these incidents by an increase in spreads over a longer period.

This reaction can be assumed to be the same for instances of manipulation. If market makers assume that they incurred losses by trading with manipulators or insiders, spreads can be expected to increase according to the models of informed trading. The presence of information seekers in the market might lead to a temporary increase in liquidity, due to an increase in trading activity alongside a slow response from the market maker, but in aggregate liquidity should decline.

This phenomenon is modelled by Allen and Gorton (1991). In their model, a market maker interprets transaction sequences regarding the probability of them being manipulation attempts. Prices are set accordingly on a gradual path, so that the manipulator just breaks even after conducting the trading sequence.

If the actions of an insider or manipulator are so well disguised as to not alert the market maker, liquidity traders are presumably equally ignorant, so that the market maker is able to recoup his losses simply through the natural market dynamics.

Due to these components having a similar aggregate effect in terms of liquidity, increasing the rigor of required insider reporting and manipulation detection should lead to more confident market makers and liquidity traders and, therefore, an increase in liquidity, as found for example by Eleswarapu and Venkataraman (2005).

In terms of volatility, the relationship between insider trading and market manipulation as well as the aggregate effect of regulating both practices is less clear. Hasbrouck (1991) states that two stocks that are similar in underlying fundamentals and in the intensity of information arrival should have a similar long-term variance.

The presence of insiders in the market should increase the rate of information arrival and should therefore differentiate the long-term variance of similar stocks with different degrees of insider trading. This notion is supported by the findings of Du and Wei (2002) and Cumming et al. (2011), the study of whom also shows that more intense market abuse regulation is related to a lower long-term volatility.

A distinction has to be made however between insider trading and market manipulation in terms of their effect on short-term volatility. In contrast to insider trades, manipulative trades contain no private information in relation to the stock's fundamentals or potential mispricing. Such a trade therefore induces short-term volatility to a higher degree, than the natural process of price discovery, as Aitken et al. (2015) state.

We therefore expect the short-term volatility of a stock, in which insiders trade, to be more closely linked to its long-term volatility, compared to the relative volatility of a stock with recurring manipulation. Drawing from the mentioned literature, it is likely that the implementation of MAR leads to a decreasing long-term volatility. If MAR successfully deters both insider trading and manipulation, its effects on the ratio of short- to long-term volatility should counteract each other. A lower frequency of manipulation should decrease short-term pricing errors and therefore reduce the ratio, while the beneficial effect of insider trading on price discovery should also be lessened, increasing the ratio.

2.4 Market Integrity

Market integrity is announced in MAR to be the primary goal of the regulation, there exists however an inconsistency in how the concept of market integrity is defined in the literature.

MAR describes market integrity as a prerequisite for integrated and efficient financial markets (EU regulation no 596/2014). The legal document itself provides no further explanation on the topic, other than that market abuse harms this integrity and destroys public confidence in financial markets. According to this statement, market integrity is seen as the mere absence of market misconduct. As it is the nature of different forms of misconduct to be hard to detect, it is difficult

to estimate the level of market abuse in the market, and the lack of a quantifiable definition complicates the evaluation of the law's success.

There have been a number of studies, focussing on the measurement of the frequency and the characteristics of different types of manipulation (e.g. "Spoofing" by Lee et al. (2013), "Ramping" by Aitken et al., 2015). In terms of manipulation techniques, spoofing and ramping have specific mathematical definitions. Using this definition, researchers can identify the number of instances in a timeframe, where a security showed manipulation characteristics (alerts). Other manipulation techniques are harder to detect and therefore it is not feasible to conclusively measure an amount of abuse in the market. To obtain testable hypotheses, the sparsely explained concept of market integrity and its relationship to market efficiency has to be investigated further.

According to Fama (1970), markets are efficient when prices fully reflect all available information at any time. Margotta (2011) emphasizes that this includes correct as well as incorrect information. According to him, a price can be efficient, even if it incorporates publicly available misleading information. He defines market integrity as the situation in which "stock prices are set in a market free from misinformation". While this definition is closely related to that of MAR, it does not equip us with tools for measurement.

Bhattacharya et al. (2000) silhouette market integrity as the absence disadvantages outsiders encounter when trading in contrast to insiders. From the previously mentioned models of informed trading we know these disadvantages. Outsiders incur the insider's abnormal returns as costs, and have to endure decreasing liquidity, as the market makers increase the spread. While the authors mainly focus on insider trading and hence their perception of market integrity is angled solely in that direction, disregarding other types of market abuse, their definition surrounds observable parameters. On the scale of these parameters, the effect of MAR could be analysed.

Comerton-Forde and Rydge (2006) move away from the traditional set of explanations as well. They define market efficiency as the ability of traders to transact with ease and at low costs, market integrity being the degree to which markets are fair and prices reflect information. According to Fama (1970), the absence of transaction costs is one of the three sufficient market conditions under which prices are efficient. Comerton-Forde and Rydge (2006) limit the scope of market efficiency with their definition, while subsuming classic elements of both concepts under the mantle of market integrity.

These past studies can be divided into two groups. Either, the concept of market integrity is described in an abstract manner, as the absence of market abuse that prevents the market from being efficient, or it is defined as some observable parameter, traditionally associated with market efficiency. Dependent on which definition is used, measures of market efficiency are then employed to quantify market integrity directly, or they at least allow indirect conclusions to be drawn.

2.5 Hypothesis development

In this chapter, we have presented the theoretical background on the main components of MAR, the market dynamics associated with them, as well as the goal horizon upon which to measure the success of its implementation.

If the regulation has achieved what it was set out to, i.e. to ensure market efficiency via the reduction of market abuse, an improvement should be seen in the inhibited measures of market efficiency, as well as a decline in the symptoms of manipulation and insider trading. This is reflected in the hypotheses postulated below.

H1: The implementation of MAR leads to a reduction in bid-ask spreads.

H2: The implementation of MAR leads to a reduction in transitory volatility.

Decreased liquidity has been found in the past literature to be the effect the different practices of market abuse have in common (see Cheng et al. (2006) and Gu and Li (2004) for insider trading; see Van Bommel (2003) and Chakraborty and Yilmaz (2004) for market manipulation). We expect the regulation to reduce this effect, if it proves successful in deterring market abuse.

In accordance to the goal horizon of the regulation, this same deterrence would be expected to increase market efficiency and therefore decrease transitory volatility. If MAR indeed inhibits market abuse, an alternative scenario is imaginable as well. Based on the literature on the positive contribution of insider trading on price discovery (e.g. Foucault et al., 2013) we can expect counteracting effects of a reduction in insider trading and market manipulation. The sign and the magnitude of the effect of MAR on transitory volatility would then depend on the relative size of the reduction in the different outlawed practices.

3. Methodology

3.1 Philosophy of social sciences and research ethics

In order to accomplish the goals of our research, we take a positivistic stance. Central to this philosophy is the opinion that scientific insight is gained by generating data through observation of reality, from which relationships and generalizations can be derived (Saunders et al., 2012). We hold an objective view in regard to the obtained results and interpret these solely from a non-subjective standpoint.

Our research follows a deductive approach. We use existing theory and literature to derive our hypotheses. The validity of these hypotheses is evaluated by executing a quantitative methodology on an empirical dataset, which we obtain from publicly available sources.

An ethical aspect to be noted is our cooperation with and funding by Scila in conducting this study. Our study however, including all results and conclusions, is not affected in any way by this association. Another aspect related to the ethics of this study represents the use of Turquoise and Nasdaq Stockholm trading venues as treated and control groups. Both venues have been selected, maintaining the assumption that they are representative of their groups. Thus, neither is any of them favoured nor are we related in any way to these. The methodology applied in this study is thoroughly explained, which should make it accessible for replication by other academic researchers.

The results are obtained by following due scientific process and are not framed in any way to be partial to or to benefit Scila.

3.2 Empirical setting

With the implementation of MAR, an extension of market abuse legislation to previously unregulated venues has taken place. This development presents the opportunity to compare such a venue to an exchange that has already been subject to market abuse legislation.

To assess the impact of MAR on different components of market efficiency, namely liquidity and transitory volatility, we employ a specific kind of event study methodology, called difference-in-differences-method. This method estimates the difference of a dependent variable between two groups, after one receives a treatment while the other does not. The main assumption of this model is that the dependent variable would follow the same trend in both groups, if the treatment event did not occur. The regulated exchange functions as the control group in this

scenario, while the MTF functions as the treated group. We expect the tightening of an already existing abuse prevention framework to have a more nuanced effect compared to that of an initial implementation.

As the venue, the stocks of which comprise the control group in our study, we choose Nasdaq Stockholm. The reasoning behind this choice is that the international comparison of exchange trading rules by Cumming et al. (2011) shows Nasdaq Stockholm to be one of the tightest regulated exchanges in Europe in terms of insider trading and manipulation regulation prior to the implementation of MAR. Therefore, we expect the effect of MAR to be minimal on this venue.

While there are several Swedish MTFs, like Spotlight and Nasdaq First North, their business models consist of offering equity from emerging-market-firms with low trading volume and capitalisation, stocks of which are not traded on the regulated exchange. This inhibits comparability and prevents us from obtaining meaningful measures of liquidity. We choose the London-based MTF Turquoise as the treatment group, which is one of the largest MTFs affected by the regulatory change where a large number of Swedish stocks are traded. Due to their size and trading activity, Chi-X and BATS would be viable alternatives.

This setting enables us to choose a sample of stocks that are traded on both Nasdaq Stockholm and Turquoise. The respective stocks in the treated group, therefore, are equal to their counterparts in the control group in terms of the intensity of public information arrival and the underlying fundamentals.

Formally, the treatment event of this study is clearly defined. MAR was passed on the 16th of April 2014 to enter into force on the 3rd of July 2016 in all member states of the European Union. A potential disruption would be if the law allowed for a transitional period for the adjustment of surveillance and infrastructural standards of the exchanges after coming into effect. According to guidelines published by the British financial supervisory authority (Financial Conduct Authority, 2016), this is not the case and the date is the strict deadline for compliance for all venues including Turquoise.

For each of the venues, we run a regression with measures of liquidity or transitory volatility as dependent variable to assess the magnitude of a potential effect of the implementation of MAR. Additionally, a dummy variable is included for the identity of each stock to control for entity-fixed effects.

We use, then, a difference-in-differences specification to evaluate the relationship between the implementation of MAR and our dependent variables, while additionally controlling for the

association with the trading venue. Adapting the model proposed by Beck et al. (2010), we utilize the following regression equation:

$$Y_{st} = \alpha + \beta TRQX_s MAR_t + A_s + B_t + \epsilon_{st} \qquad Eq.\ 1$$

Where $TRQX$ is a dummy with a value of one if the observation is associated with Turquoise and zero otherwise, MAR is a dummy indicating if the observation lies after the event, and A and B are dummy-vectors for entity-fixed and time-fixed effects. We include these dummy vectors to account for unobserved effects and trends that might systematically influence the dependent variable. Examples for such effects are macroeconomic changes (time-fixed) or the industry in which a firm operates (entity-fixed). The relevance of these effects and their inclusion in the model is verified by comparing the results of F-tests and the Hausman-test for the fixed effects model with those of a basic pooled OLS regression model.

3.3 Sampling and data

Our data consists of the 1-minute quote-data, between December 2015 and December 2016 on a sample of 130 stocks, which we obtained from the Thomson Reuters Tick History database. It contains the best bid and ask prices for the open and the close of each one-minute interval. The stocks were selected, by first categorising all stocks traded on both Nasdaq Stockholm and Turquoise by their market capitalisation and then drawing a random sample from each of the three categories (small, mid, and large).

The distinction by market capitalisation is relevant, as Lee et al. (2013) and Aggarwal and Wu (2004) among others find the frequency of market manipulation to be negatively correlated with capitalisation.

The large-cap group consists of 47, the mid-cap of 36, and the small-cap group of 47 stock pairs. We exclude stocks from our initial sample, that are not traded over the whole sampling timeframe on one or both of the venues. This exclusion explains the non-uniform number of stocks per category. As the regressions are run on the three groups independently, the difference in the number of stocks does not affect our model. In Appendix I, we report the list of sampled stocks, including descriptions of their characteristics, obtained from the database.

The aggregation level of one minute is chosen as it allows us to feasibly investigate a longer timeframe in the search for short- and long-term effects, while still providing the necessary level of detail for calculating liquidity and short-term volatility.

Regressions are run for the three capitalisation groups, giving a point of comparison and controlling for a factor (capitalisation) identified in the literature to be relevant for the frequency of abuse.

A potential limitation of this research design is seasonality. While we can control for time-fixed effects to a certain degree, the dataset only spans a timeframe of 12 months. To control for potential yearly recurrence-patterns of our dependent variables, the timeframe would have to be extended to include several years.

3.4 Measures

In the following section, we outline the measures used for assessing the effects of MAR. We will derive the measures that are most likely to be affected by the regulatory change and give insight on the truthfulness of our hypotheses. These measures will function as the dependent variables in the model outlined in Equation 1.

3.4.1 Liquidity

While there are a number of measures for liquidity, we use the most widely used one in the market abuse literature, i.e. the quoted spread. For each interval, we calculate the average bid- and ask quotes as the midpoint of the opening and closing quotes. The midprice is obtained by averaging each period's bid- and ask price. The average quoted spread each minute is then calculated according to the following formula:

$$s(q) = \frac{\overline{a}(q) - \overline{b}(q)}{m} \qquad \textit{Eq. 2}$$

Where $\overline{a}(q)$ is the average ask, $\overline{b}(q)$ the average bid, and m the midprice. This process yields a negative spread in a few trading-periods on Turquoise, which were removed from the sample. The remaining data is winsorized at the 1% and 99% level and subsequently used to calculate weekly averages of the quoted spread per stock.

3.4.2 Transitory volatility

To measure a potential effect of MAR on volatility, general measures are insufficient. There are too many factors and too much randomness influencing stock returns. A measure of volatility has to be obtained that has a higher correlation with market abuse than the general one.

The volatility induced by manipulation is limited to the manipulation period. As we have discussed earlier, noise traders react to the price changes brought forth by manipulators and insiders, causing an increase in volatility. In theory, private information would then become public and the price would revert to the level that incorporates public information and potentially the private information extracted from the insider's trade. In case of a manipulation attempt, the price should revert to its previous level, and the increase in volatility should subside. Contrasting short- and long-term volatility should therefore give us an understanding of the degree of market abuse. While this transitory volatility can have a variety of causes, systemic ones should be eliminated by the comparative design of our study.

We follow the approach taken by Ito et al. (1998), by first calculating the midprice-return of each period as the change in the log midpoint of the bid and ask price. We winsorize the thereby obtained returns at the 1% and 99% levels.

This process is followed for the one-minute intervals. The variance of one-minute-returns is aggregated per week to obtain a time-series of variances. We then define intervals of increasing length, for which the returns and variances calculated in the same manner: 5 minutes and 30 minutes (similarly to Ozenbas, 2006). We expect these intervals to be most conclusive in regard to the impact of market abuse, considering speed of quote revision and price impact (Dufour and Engle, 2000). The variance ratios obtained by dividing the shorter period variances by the longer period variances represent the fraction of short-term volatility. The general formula for the variance ratios is given by:

$$VR(m) = \frac{mVar[r_t(1)]}{Var\left(r_t(m)\right)} \qquad \textit{Eq. 3}$$

where *r* represents the return over a particular period and *m* is the period multiplier of a longer interval. Campbell et al. (1997) derive variance ratios as a method to test the random walk hypothesis. If a stock's return indeed follows a random walk, the variance ratio should be unity. Deviations from unity stem from serial autocorrelation in the stock returns, caused by trading frictions like short-term pricing errors.

4. Findings and analysis

In this section, the quantitative results of our study are presented. We first analyse the descriptive statistics of the measures, introduced in the previous chapter, to get an overview of potential changes after the implementation of MAR. Secondly, the results for the panel data regressions are presented and analyzed.

4.1 Descriptive statistics

4.1.1 Liquidity

Table I shows descriptive statistics of the quoted spread across venues and market capitalisations for the complete timeframe of obtained data, where the before and after event timeframe each represent half a year:

Table I: Descriptive statistics of the quoted spread (in percent) before and after the implementation of MAR per venue and capitalisation level

	Nasdaq Stockholm					
	Large		Mid		Small	
	before event	after event	before event	after event	before event	after event
Mean	0.342740	0.287695	0.739665	0.595682	1.757827	1.361684
10-percentile	0.088809	0.081978	0.372503	0.347610	0.567888	0.531803
90-percentile	0.623663	0.630864	1.302621	0.918929	3.388881	2.327021
St.dev	0.535583	0.455255	0.448965	0.313018	1.964523	1.259301

	Turquoise					
	Large		Mid		Small	
	before event	after event	before event	after event	before event	after event
Mean	0.713674	0.716300	2.290350	1.389697	2.658292	1.856004
10-percentile	0.124660	0.117668	0.421341	0.270216	0.279966	0.059435
90-percentile	1.898750	1.820968	4.264931	2.918691	6.111342	4.471230
St.dev	0.908668	0.906625	4.560949	1.829198	3.230334	2.459004

It can be noted here that the average quoted spread is negatively correlated with capitalisation level, as theory suggests. Furthermore, the mean as well as the standard deviation of the quoted spread are lower in the half-year-period subsequent to the implementation of MAR across all capitalisation levels and venues, except for the large-cap group on Turquoise. For the mid- and small-capitalisation levels, the decrease is stronger on Turquoise than on Nasdaq Stockholm in relative terms, which is in line with our expectations.

The magnitude of the quoted spread is uniformly higher on Turquoise compared to Nasdaq Stockholm. Similarly, Riordan et al. (2015) find the spread on Turquoise to be substantially higher than that on the LSE.

Figures I, II, and III display the development of the average quoted spread (in percent) over time for the panel of stocks for each capitalisation group.

Fig. I: Average quoted spread of large-cap stocks from December 2015 to November 2016

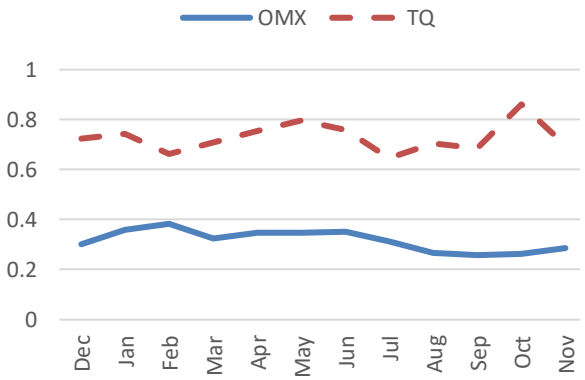


Fig. II: Average quoted spread of mid-cap stocks from December 2015 to November 2016

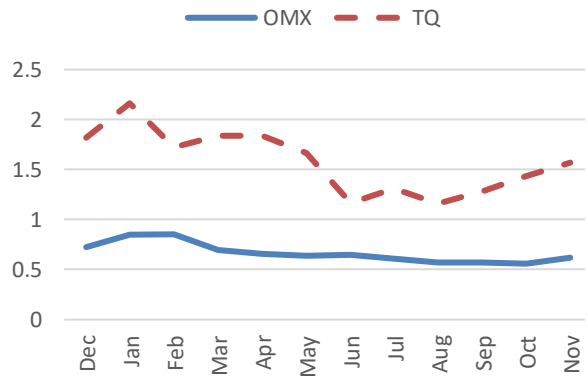
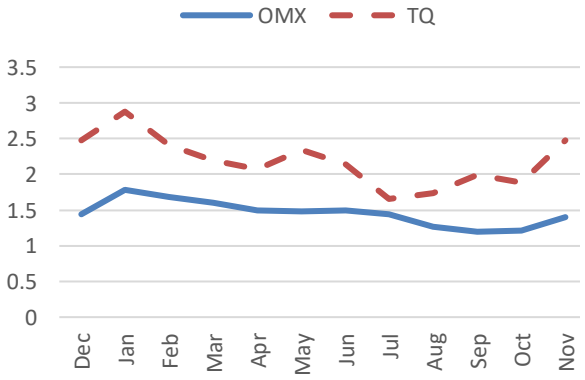


Fig. III: Average quoted spread of small-cap stocks from December 2015 to November 2016



The development on Nasdaq Stockholm seems to be relatively steady, all capitalisation levels experiencing an increase at the beginning of the year, followed by a slight decline over the course of the year. The tightest average spreads across all capitalisation levels seem to be observable in June or July, shortly after the implementation of MAR.

4.1.2 Transitory volatility

Table II displays the descriptive statistics of the 5-to-30-minute variance ratios, where the before and after event windows each span half a year:

Table II: Descriptive statistics of the 5-to-30-minute variance ratios before and after the implementation of MAR per venue and capitalisation level

	Nasdaq Stockholm					
	Large		Mid		Small	
	before event	after event	before event	after event	before event	after event
Mean	1.046235	1.105438	1.095807	1.104277	1.417627	1.484402
10-percentile	0.674675	0.744936	0.651019	0.723604	0.741829	0.831731
90-percentile	1.464697	1.476207	1.590932	1.578441	2.283302	2.411308
St.dev	0.395027	0.435504	0.470838	0.387979	0.733885	0.719553

	Turquoise					
	Large		Mid		Small	
	before event	after event	before event	after event	before event	after event
Mean	1.603079	1.846187	1.475505	1.681867	1.811171	1.898048
10-percentile	0.903949	0.947952	0.713087	0.784778	0.811810	0.831318
90-percentile	2.649753	3.190099	2.487785	3.023806	3.433890	3.734295
St.dev	0.771267	0.907779	0.789815	0.898860	1.056396	1.132736

As can be seen in Table II, the difference between unity and the observed variance ratio decreases with the capitalisation level on the regulated exchange, hinting towards a more efficient market for larger capitalisation levels.

On Turquoise, the variance ratios are significantly higher than on Nasdaq Stockholm and the relationship between capitalisation and the magnitude of the variance ratio does not hold. A potential explanation for this occurrence is that the vastly higher trading volume on the regulated exchange leads to a more efficient market.

Across all capitalisation levels and both exchanges, the means of the variance ratios are higher subsequently to the implementation of MAR, while the relative increase is larger on the MTF. The estimation of the difference-in-differences model will give further insight into this potential effect.

Figures IV, V, and VI display the development of the average 5-to-30-minute variance ratios over the course of the sampled timeframe.

Fig.IV: Average variance ratios of large-cap stocks from December 2015 to November 2016

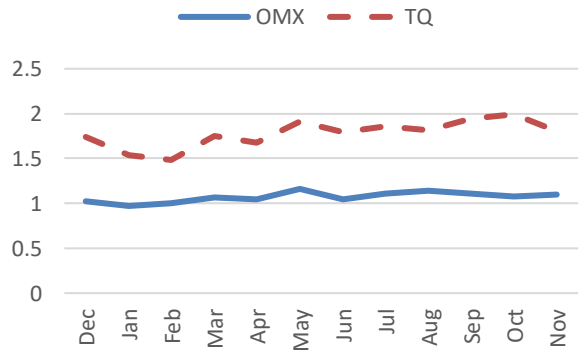


Fig.V: Average variance ratios of mid-cap stocks from December 2015 to November 2016

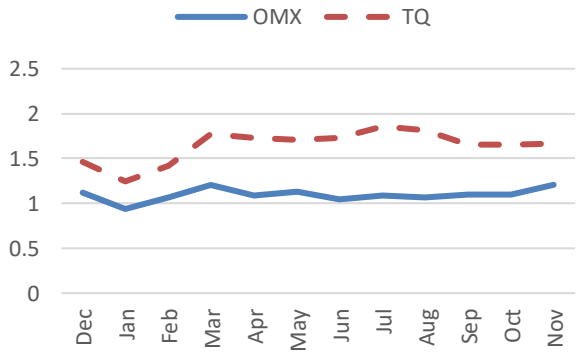
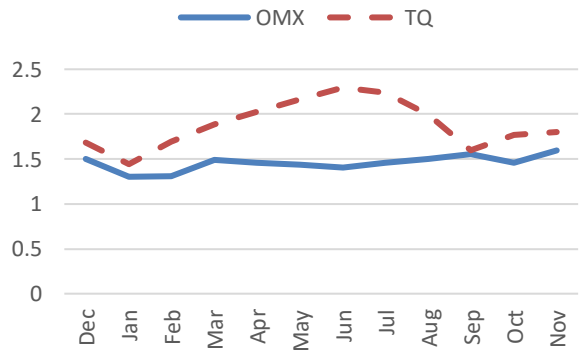


Fig. VI: Average variance ratios of small-cap stocks from December 2015 to November 2016



As observed before in the average quoted spread, the average variance ratios seem to exhibit a relatively steady movement on Nasdaq Stockholm. The development of the mid- and large-cap variance ratios on Turquoise is similar to that of Nasdaq Stockholm, albeit with more pronounced fluctuations. The largest deviation can be observed in the small capitalisation group, where the Turquoise variance ratios increase until experiencing a turning point in June, after which they gradually fall to the level of Nasdaq Stockholm.

4.2 Difference-in-differences method

4.2.1 Liquidity

To assess if the effects of the implementation of MAR, suggested by the change in means seen in the descriptive statistics, are statistically significant, we conduct fixed-effects panel data regressions according to the difference-in-differences methodology.

In table III, the coefficients of the difference-in-differences equation are presented for the period spanning three months before and three months after the implementation of MAR. The regression model does not account for unobserved time- or entity-fixed effects but yields an overview of the dynamics between the control and the treated group before and after the event.

Table III: Difference-in-differences coefficients with the quoted spread (in percent) as the dependent variable for the six-month timeframe

	Coefficient	Standard Error	t-statistic	p-value
Large				
Intercept	0.338565	0.032410	10.446290	0
MAR	-0.031341	0.046708	-0.671009	0.502300
TRQX	0.334677	0.046592	7.183092	0
MAR*TRQX	0.006865	0.066996	0.102467	0.918400
Mid				
Intercept	0.665542	0.091328	7.287373	0
MAR	-0.058542	0.131504	-0.445169	0.656200
TRQX	0.573620	0.140968	4.069156	0
MAR*TRQX	-0.475644	0.201632	-2.358969	0.018400
Small				
Intercept	1.691524	0.103220	16.387500	0
MAR	-0.250523	0.148354	-1.688686	0.091400
TRQX	0.113669	0.148050	0.767776	0.442700
MAR*TRQX	-0.985931	0.212465	-4.640451	0

The time dummy variable (MAR) exhibits a marginally significant, negative coefficient for the small-cap group. For the higher capitalisation levels, we estimate negative coefficients for our sample as well, albeit insignificant ones.

The treatment effect (MAR*TRQX) is significant and negative for the mid-cap and small-cap subgroups, suggesting an increase in liquidity after the regulation came into effect. However, the magnitude of the effect is greater for the latter, where the difference of the two coefficients represents *0.510287%.*

Table IV displays the coefficient of the treatment effect when regressed on the quoted spread according to eq. 1 for different timeframes symmetric around the event, which gives an understanding of how the treatment effect changes over time.

Table IV: Estimation of the regression coefficients of the difference-in-differences dummy with the quoted spread (in percent) as dependent variable

	Coefficient	Standard Error	t-statistic	p-value
Large				
twelve months	0.049842	0.033340	1.494969	0.135000
six months	0.003102	0.051584	0.060143	0.952000
two months	0.032717	0.104147	0.314146	0.753500
Mid				
twelve months	-0.764643	0.163493	-4.67693	0
six months	-0.489791	0.195714	-2.50259	0.012400
two months	0.215588	0.280237	0.769304	0.442000
Small				
twelve months	-0.716137	0.137709	-5.20035	0
six months	-0.996076	0.180714	-5.51188	0
two months	0.020632	0.302894	0.068115	0.945700

We obtain significant results for the twelve- and six-month timeframes in the small- and mid-capitalisation groups. The coefficients of the treatment effect for all sampling periods in the large-cap group are insignificant, so that we cannot confidently infer a treatment effect different from zero.

The significant results indicate a decreasing effect of the implementation of MAR on the quoted spread and therefore an increase in liquidity, which confirms our first hypothesis that the implementation of MAR decreases the bid-ask spread.

The liquidity increase is strongest for small-cap stocks in the six-month period surrounding the event. The mid-cap stocks exhibit an effect of half the magnitude of the small-cap stocks. When compared on the twelve-month level, small- and mid-capitalisation stocks experience a similar degree of change in liquidity, with mid-cap displaying a slightly stronger effect by *0.048506%.*

Illiquid stocks with lower trading activity, like the stocks in our small-cap group, have been shown to be most frequently targeted by market abuse. The effect of MAR on liquidity being the most pronounced in this group of our sample suggests that the introduced disclosure and surveillance requirements might indeed deter market abuse.

As our measure of liquidity is based on quotes and not on trades, it represents market makers' perception of the order flow and the market to a certain degree. A tightening of the spreads subsequent to the event could therefore also indicate an increase in trust in the integrity of the market.

4.2.2 Transitory volatility

In this section, we present the regression results of the difference-in-differences model with the variance ratio as the dependent variable. The descriptive statistics have shown us, that the average transitory volatility increases in the half year after the event compared to the one before, which suggests an increased degree of mispricing and therefore of inefficiency. This effect would be opposing the goal of MAR to ensure market efficiency.

Table V displays the estimated coefficients for all dummy variables without accounting for fixed effects in sampling frame of three months before and after the implementation of the regulation.

Table V: Difference-in-differences coefficients with the 5-to-30 minute variance ratio as dependent variable for the six-month timeframe

	Coefficient	Standard Error	t-statistic	p-value
Large				
Intercept	1.091219	0.030139	36.206200	0
MAR	0.010207	0.043435	0.234996	0.814200
TRQX	0.671176	0.043581	15.400680	0
MAR*TRQX	0.054557	0.062661	0.870666	0.384000
Mid				
Intercept	1.137021	0.033120	34.329920	0
MAR	-0.070451	0.047690	-1.477262	0.139800
TRQX	0.593278	0.051871	11.437550	0
MAR*TRQX	0.139597	0.073877	1.889587	0.059000
Small				
Intercept	1.461801	0.041222	35.461350	0
MAR	-0.004940	0.059247	-0.083376	0.933600
TRQX	0.569706	0.059247	9.615761	0
MAR*TRQX	0.134590	0.085086	1.581800	0.113800

The only treatment related variable, for which we find a marginally significant relationship to the dependent variable, is the treatment effect variable in the mid-cap group. As suggested by the descriptive statistics, the variance ratios increase subsequent to the event for the mid-cap level.

Table VI summarizes the treatment effect coefficients for different time horizons for the three subgroups when controlling for unobserved fixed effects.

Table VI: Estimation of the regression coefficients of the difference-in-differences dummy with the 5-to-30 minute variance ratio as dependent variable

	Coefficient	Standard Error	t-statistic	p-value
Large				
twelve months	0.111007	0.03646	3.044625	0.002300
six months	0.046347	0.05241	0.884306	0.376600
two months	0.001422	0.099795	0.014252	0.988600
Mid				
twelve months	0.102173	0.043513	2.348116	0.018900
six months	0.119472	0.066823	1.787893	0.074000
two months	0.089238	0.111892	0.797539	0.425500
Small				
twelve months	0.016924	0.053882	0.314087	0.753500
six months	0.119421	0.07852	1.520901	0.128400
two months	0.143973	0.141116	1.020248	0.307900

As seen in table VI, a significant effect of the implementation of MAR at the 5% level is estimated for the full-year period in the large-cap and mid-cap subgroups. The marginally significant result for the treatment effect in the six-month period, presented in table V, is confirmed when accounting for fixed effects.

For the small-cap group, we cannot identify a correlation different from zero between the treatment and the variance ratio for any of the timeframes.

The significant results, we are able to obtain, all point towards MAR having an increasing effect on the variance ratio and therefore the degree of inefficiency. Our data is insufficient to make inferences regarding the small-cap group of stocks, which, according to the literature, would be most affected by a change in regulation. Our hypothesis, that the implementation of MAR decreases transitory volatility, is not supported by the data and the significant quantitative results indicate a contrarian effect.

5. Discussion

5.1 Main contributions

The goal, MAR is set out to accomplish, is to prevent abuse in financial markets across the EU member states. Its intent is to thereby ensure a more trustworthy, fair, and efficient trading environment.

We gauge the success of the regulatory framework in achieving this objective by measuring the effect of its implementation on two components of market efficiency, likely to be affected by market abuse.

Regarding liquidity, the difference-in-difference-model provides significant estimators for mid-cap and small-cap stocks, indicating a decrease in bid-ask spreads and therefore an increase in liquidity following the implementation of MAR. These results support the findings of Cummings et al. (2011), who assess that the strictness of market abuse legislation is negatively correlated with the bid-ask spread.

The analysis of the different capitalisation groups shows that the liquidity effect of the regulation is strongest in the small-cap group, which complements the conclusions by Aggarwal and Wu (2006) and Lee et al. (2012) that small and illiquid stocks are most likely to be targeted by manipulators. Degryse et al. (2015) find the abnormal losses, market makers incur by trading with insiders, to be largest for small-cap stocks. Therefore, market makers would be inclined to charge large spreads on small-cap stocks to break even in equilibrium (which is confirmed in our descriptive statistics). Hence discouraging insider trading would presumably have a strong effect on market maker's abnormal losses and therefore the spreads in this segment.

The increase in liquidity due to the regulation is also in line with the modelled dynamics of informed trading by Glosten and Milgrom (1985) and Kyle (1985). Disclosure and surveillance requirements, as well as the maintenance of insider lists reduce the probability that manipulators and insiders participate in the market undetected. The modelled market maker then is less likely to unknowingly trade with an insider or manipulator and his expected loss is lower, allowing him to charge tighter equilibrium spreads.

For the transitory volatility, we obtain significant results for large-cap and mid-cap stocks, indicating an increasing effect of the regulation on the dependent variable, suggesting a higher short-term price inefficiency. These results confirm the claim made by Foucault et al. (2013) that there seems to be a trade-off between price discovery and liquidity when it comes to insider trading regulation.

John and Narayanan (1997) and Huddart et al. (2001) extend classic models of informed trading by introducing the regulatory requirement for insiders to publicly disclose their trades after their execution. In such a situation, the equilibrium strategy of the insider requires him to occasionally trade against his private information, therefore creating short-term noise. MAR introduces such disclosure requirements (or respectively increases the urgency of the reporting timeframe, dependent on previous regulation of the venue). Our results conform to the scenario the authors outline, hence the increase in transitory volatility could therefore be due to the dynamics modelled by John and Narayanan (1997) and Huddart et al. (2001).

In the hypothesis development, we speculate that the effect of MAR on transitory volatility would depend on the degree of deterrence regarding the different practices. Based on the literature concerning the positive effect of insider trading on price discovery and assuming that our model sufficiently controls for external effects other than the implementation of MAR, the change in the transitory volatility would either be due to an unobserved effect of the law, or due to a change in the relative frequency of market abuse practices. The models by John and Narayanan (1997) and Huddart et al. (2011) in conjunction with our results suggest that the balance between insider trading and market manipulation shifts towards a less efficient state due to insiders exhibiting non informative behaviour or being deterred more strongly than manipulators following the implementation of MAR.

In the light of our results, significant and insignificant, and their interpretation, it seems that we cannot confidently say that MAR only has positive effects. There seem to be drawbacks associated with the presumed increase in market integrity.

The observed pattern of increasing liquidity and decreasing price accuracy as result of the implementation of the new regulation corresponds to dynamics of insider trading identified by other authors. Our study therefore contributes to the body of literature on the potential harmfulness of insider trading and the regulation thereof, by confirming the modelled dilemma in an empirical environment.

5.2 Limitations

In our study, we attempt to strike a balance between the sampling timeframe and the sampling frequency, to assess short- as well as long-term effects of MAR. The chosen methodology allows us to control for a large number of variables and external effects, that we do not

specifically observe in our dataset. The inclusion of an additional year of data would add robustness to our results and a more detailed perspective on potential unobserved effects or seasonality.

The aim of our study is to assess the effects and the success of MAR in achieving its goals. The reduction of market abuse however is inherently difficult to measure, and we have to rely on an indirect way to quantify it. We therefore use measures that have been found in past studies and literature to be most affected by market abuse to infer a change in its frequency.

We control for factors other than the implementation of MAR being the cause of a change in our measures by comparing a control to a treatment group. We choose Nasdaq Stockholm as our control group due to its high rigor of market abuse prevention prior to the event. This leads us to the expectation that an adjustment of the existing framework should have a smaller effect than the introduction of a wholly new regulatory framework, which we can support via an examination of the means of the relevant variables. To avoid over- or underestimating the treatment effect on the MTF, one would need a control group closely matching the treatment group while exhibiting no treatment effect at all. As it seems that there is an effect of the event on our control group, we cannot fully reject the potential of an inaccuracy of the obtained results.

The points we touch on in this section open up the possibility of further research to substantiate our findings.

5.3 Further research

Our study focuses on two venues affected by the legislation of the European Union over a timeframe of one year. A way for future studies to add robustness to our findings would be to extend the investigated timeframe to span multiple years to account for the effects of seasonality and other external events. Alternatively, a future study could compare our findings regarding the MTF Turquoise to those obtained from other MTFs or replace Nasdaq Stockholm as the control group with another European regulated exchange, exhibiting similarly rigorous market abuse prevention before the implementation of MAR.

An investigation of high frequency data would present the opportunity to delve deeper into potential liquidity effects, by introducing price impact and market depth regressions, as well as further spread measurements.

For the assessment of price discovery, we use variance ratios as a proxy for short-term pricing inefficiencies. There have been numerous studies in the past, using alternative measures of price

discovery and investigating short-term components of volatility by employing different models like the GARCH and VAR models. These methods could be adjusted to serve an event study approach as used in our study to gain additional detail and a different perspective on the effect of MAR.

Based on the literature, we have chosen an empirical approach focussed on measures that tend to be influenced by multiple practices outlawed in MAR. Limiting the focus to a specific kind of market abuse, such as ramping manipulation, could yield additional insight on the effects MAR has on the frequency and symptoms of that specific kind of abuse.

6. Conclusion

This paper investigates the effects of MAR, a regulation consolidating market abuse legislation across the countries of the European Union, and expanding it to encompass previously unregulated venues, instruments, and practices. The goal, postulated in the regulation, is to inhibit market abuse and thereby increase market efficiency.

We examine the literature on the components of MAR, expected to have the most impact on the market, insider trading and market manipulation. Markets with a stricter regulatory framework concerning market abuse are found to exhibit higher liquidity and lower volatility than those more loosely regulated.

We apply the findings of previous studies to assess the success of MAR in achieving its self-proclaimed goal and expand on the existing literature with an analysis of the pricing efficiency before and after the implementation of the law.

We employ difference-in-differences regressions with Nasdaq Stockholm as the control group and Turquoise as the treated group and find a significant correlation between MAR coming into effect and an increase in liquidity for small-cap and mid-cap stocks. It therefore seems that MAR has seen some success in deterring market abuse in the capitalisation groups, expected to be most affected by it.

We use short-term variance ratios as a proxy for short-term pricing errors. The difference-in-differences regressions on this measure estimate a significantly increasing effect of MAR for the large-cap and mid-cap groups. It therefore seems that the potential deterrence of insider trading also inhibits its positive effects on price discovery, causing the market to be more inefficient in this regard.

Our findings underline the existence of a trade-off between liquidity and price discovery elaborated by Foucault et al. (2013) among others, as well as the resulting dilemma for lawmakers. The introduction of a strict and expansive regulatory framework seems to lead to an increase in market integrity at the cost of price discovery and market efficiency.

It seems like MAR achieved the intended effect of an increased market integrity but may have failed to reach its ultimate goal of increasing efficiency via integrity.

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Appendix I: Sample of Stocks

Capitalisation	Firm	RIC		Sector
Large	AAK	AAK.ST	AAKs.TQ	Consumer Goods
Large	Alfa Laval	ALFA.ST	ALFAs.TQ	Industrials
Large	Atlas Copco A	ATCOa.ST	ATCOAs.TQ	Industrials
Large	Attendo	ATTE.ST	ATTs.TQ	Health Care
Large	Avanza Bank Holding	AVANZ.ST	AZAs.TQ	Financials
Large	Beijer Ref B	BEIJb.ST	BEIJBs.TQ	Industrials
Large	Betsson B	BETSb.ST	BETSBs.TQ	Consumer Services
Large	BillerudKorsnäs	BILL.ST	BILLs.TQ	Basic Materials
Large	Electrolux A	ELUXa.ST	ELUXAs.TQ	Consumer Goods
Large	Elekta B	EKTAb.ST	EKTABs.TQ	Health Care
Large	Ericsson B	ERICb.ST	ERICBs.TQ	Technology
Large	Fast. Balder B	BALDb.ST	BALDBs.TQ	Financials
Large	HEXPOL B	HPOLb.ST	HPOLBs.TQ	Basic Materials
Large	Holmen B	HOLMb.ST	HOLMBs.TQ	Basic Materials
Large	Hufvudstaden A	HUFVa.ST	HUFVAs.TQ	Financials
Large	ICA Gruppen	ICAA.ST	ICAs.TQ	Consumer Services
Large	Indutrade	INDT.ST	INDTs.TQ	Industrials
Large	Kinnevik A	KINVa.ST	KINVAs.TQ	Financials
Large	Klövern B	KLOVb.ST	KLOVBs.TQ	Financials
Large	Kungsleden	KLED.ST	KLEDs.TQ	Financials
Large	Latour B	LATOb.ST	LATOBs.TQ	Financials
Large	Loomis B	LOOMb.ST	LOOMBs.TQ	Industrials
Large	Lundbergföretagen B	LUNDb.ST	LUNDBs.TQ	Financials
Large	Lundin Petroleum	LUPE.ST	LUPEs.TQ	Oil & Gas
Large	Modern Times Group B	MTGb.ST	MTGBs.TQ	Consumer Services
Large	Mycronic	MYCR.ST	MYCRs.TQ	Industrials
Large	NCC A	NCCa.ST	NCCAs.TQ	Industrials
Large	NCC B	NCCb.ST	NCCBs.TQ	Industrials
Large	Nobia	NOBI.ST	NOBIs.TQ	Consumer Goods
Large	Nolato B	NOLAb.ST	NOLABs.TQ	Industrials
Large	Peab B	PEABb.ST	PEABBs.TQ	Industrials
Large	Ratos A	RATOa.ST	RATOAs.TQ	Financials
Large	SCA A	SCAa.ST	SCAAs.TQ	Basic Materials
Large	SCA B	SCAb.ST	SCABs.TQ	Basic Materials
Large	Securitas B	SECUb.ST	SECUBs.TQ	Industrials
Large	SKF B	SKFb.ST	SKFBs.TQ	Industrials
Large	SSAB B	SSABb.ST	SSABBs.TQ	Basic Materials
Large	Stora Enso A	STEa.ST	STEAs.TQ	Basic Materials
Large	Stora Enso R	STEr.ST	STERs.TQ	Basic Materials
Large	Sv. Handelsbanken A	SHBa.ST	SHBAs.TQ	Financials
Large	SWECO B	SWECb.ST	SWECBs.TQ	Industrials
Large	Tele2 B	TEL2b.ST	TEL2Bs.TQ	Telecommunications
Large	Thule Group	THULE.ST	THULEs.TQ	Consumer Goods
Large	Trelleborg B	TRELb.ST	TRELBs.TQ	Industrials

Large	Vitrolife	VITR.ST	VITRs.TQ	Health Care
Large	Volvo A	VOLVa.ST	VOLVAs.TQ	Industrials
Large	Wallenstam B	WALLb.ST	WALLBs.TQ	Financials
Mid	Addnode Group B	ANODb.ST	ANODBs.TQ	Technology
Mid	Africa Oil	AOIC.ST	AOIs.TQ	Oil & Gas
Mid	Beijer Alma B	BEIAb.ST	BEIABs.TQ	Industrials
Mid	BioGaia B	BIOGb.ST	BIOGBs.TQ	Health Care
Mid	Catena	CATE.ST	CATEs.TQ	Financials
Mid	Concentric	CONIC.ST	COICs.TQ	Industrials
Mid	Duni	DUNI.ST	DUNIs.TQ	Consumer Goods
Mid	Elanders B	ELANb.ST	ELANBs.TQ	Industrials
Mid	EnQuest PLC	ENQ.ST	ENQs.TQ	Oil & Gas
Mid	HiQ International	HIQ.ST	HIQs.TQ	Technology
Mid	HMS Networks	HMSN.ST	HMSs.TQ	Technology
Mid	I.A.R Systems Group	IARb.ST	IARBs.TQ	Technology
Mid	Inwido	INWI.ST	INWIs.TQ	Industrials
Mid	ITAB Shop Concept B	ITABb.ST	ITABBs.TQ	Industrials
Mid	Karo Pharma	KARO.ST	KAROs.TQ	Health Care
Mid	Knowit	KNOW.ST	KNOWs.TQ	Technology
Mid	Lagercrantz Group B	LAGRb.ST	LAGRBs.TQ	Industrials
Mid	Lucara Diamond Corp	LUC.ST	LUCs.TQ	Basic Materials
Mid	New Wave B	NEWAb.ST	NEWABs.TQ	Consumer Goods
Mid	Oasmia Pharmaceutical	OASM.ST	OASMs.TQ	Health Care
Mid	OEM International B	OEMb.ST	OEMBs.TQ	Industrials
Mid	Orexo	ORX.ST	ORXs.TQ	Health Care
Mid	Proact IT Group	PACT.ST	PACTs.TQ	Technology
Mid	Probi	PROB.ST	PROBs.TQ	Health Care
Mid	Qliro Group	QLRO.ST	QLROs.TQ	Consumer Services
Mid	Recipharm B	RECIb.ST	RECIBs.TQ	Health Care
Mid	Rottneros	RROS.ST	RROSs.TQ	Basic Materials
Mid	SAS	SAS.ST	SASs.TQ	Consumer Services
Mid	Scandi Standard	SCST.ST	SCSTs.TQ	Consumer Goods
Mid	Scandic Hotels Group	SHOTE.ST	SHOTs.TQ	Consumer Services
Mid	Semafo	SMF.ST	SMFs.TQ	Basic Materials
Mid	SkiStar B	SKISb.ST	SKISBs.TQ	Consumer Services
Mid	Swedol B	SWOLb.ST	SWOLBs.TQ	Consumer Services
Mid	Tethys Oil	TETY.ST	TETYs.TQ	Oil & Gas
Mid	Vitec Software Group B	VITb.ST	VITBs.TQ	Technology
Mid	XANO Industri B	XANOb.ST	XANOBs.TQ	Industrials
Small	Active Biotech	ACTI.ST	ACTIs.TQ	Health Care
Small	Anoto Group	ANOT.ST	ANOTs.TQ	Technology
Small	Beijer Electronics Group	BELE.ST	BELEs.TQ	Industrials
Small	Björn Borg	BORG.ST	BORGs.TQ	Consumer Goods
Small	Bong	BOLJ.ST	BONGs.TQ	Industrials
Small	Boule Diagnostics	BOUL.ST	BOULs.TQ	Health Care
Small	Concordia Maritime B	CCORb.ST	CCORBs.TQ	Industrials
Small	Consilium B	CONSb.ST	CONSBs.TQ	Industrials
Small	Dedicare B	DEDIC.ST	DEDIs.TQ	Health Care

Small	Electra Gruppen	ELEC.ST	ELECs.TQ	Consumer Services
Small	Elos Medtech B	ELOSSb.ST	ELOSBs.TQ	Health Care
Small	Eniro	ENRO.ST	ENROs.TQ	Consumer Services
Small	eWork Group	EWRK.ST	EWRKs.TQ	Industrials
Small	Feelgood Svenska	FEEL.ST	FEELs.TQ	Health Care
Small	FormPipe Software	FPIP.ST	FPIPs.TQ	Technology
Small	GHP Specialty Care	GHP.ST	GHPs.TQ	Health Care
Small	Image Systems	ISY.ST	ISs.TQ	Industrials
Small	Karolinska Development B	KDEV.ST	KDEVs.TQ	Health Care
Small	Lammhults Design Group B	LAMMb.ST	LAMMBs.TQ	Consumer Goods
Small	Malmbergs Elektriska B	MEABb.ST	MEABBs.TQ	Industrials
Small	Medivir B	MVIRb.ST	MVIRBs.TQ	Health Care
Small	Micro Systemation B	MSABb.ST	MSABBs.TQ	Technology
Small	Midway A	MIDWa.ST	MIDWAs.TQ	Financials
Small	Midway B	MIDWb.ST	MIDWBs.TQ	Financials
Small	Moberg Pharma	MBPH.ST	MOBs.TQ	Health Care
Small	MQ Holding	MQH.ST	MQs.TQ	Consumer Services
Small	MultiQ International	MULQ.ST	MULQs.TQ	Technology
Small	NAXS	NAXS.ST	NAXSs.TQ	Financials
Small	NOTE	NOTE.ST	NOTEs.TQ	Industrials
Small	NOVOTEK B	NTEKb.ST	NTEKBs.TQ	Technology
Small	Odd Molly International	ODD.ST	ODDs.TQ	Consumer Goods
Small	Ortivus A	ORTIa.ST	ORTIAs.TQ	Health Care
Small	Ortivus B	ORTIb.ST	ORTIBs.TQ	Health Care
Small	Poolia B	POOLb.ST	POOLBs.TQ	Industrials
Small	Precise Biometrics	PREC.ST	PRECs.TQ	Industrials
Small	Pricer B	PRICb.ST	PRICBs.TQ	Industrials
Small	Profilgruppen B	PROFb.ST	PROFBs.TQ	Basic Materials
Small	Rejlers B	REJLb.ST	REJLBs.TQ	Industrials
Small	RNB RETAIL AND BRANDS	RNBS.ST	RNBSs.TQ	Consumer Services
Small	Semcon	SEMC.ST	SEMCs.TQ	Industrials
Small	Sensys Gatso Group	SENS.ST	SENSs.TQ	Industrials
Small	SinterCast	SINT.ST	SINTs.TQ	Industrials
Small	Softronic B	SOFb.ST	SOFBs.TQ	Technology
Small	Studsvik	SVIK.ST	SVIKs.TQ	Industrials
Small	Svedbergs B	SVEDb.ST	SVEDBs.TQ	Industrials
Small	Trention	TRENT.ST	TRENTs.TQ	Consumer Goods
Small	Venue Retail Group B	VRGb.ST	VRGBs.TQ	Consumer Services

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