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Market in Financial Instruments Directive (MiFID), stock price informativeness and liquidity

Abstract

The paper examines the impact of MiFID on stock price informativeness and liquidity in 28 EU countries. We find that post-MiFID the stock prices reflect greater firm specific information and the market becomes more liquid. Consistent with the 'Catch-up Hypothesis' our evidence shows that the impact of MiFID in terms of price informativeness is greater for countries that have weaker quality of regulation. We find that regulation with enforcement improves market efficiency. Our results are robust with respect to the choice of price informativeness and liquidity proxies as well as the control sample.

Keywords: Capital markets; disclosure regulation; transaction costs; bid-ask spread; propensity score matching.

JEL Classification: G18, G28

1. Introduction

The Market in Financial Instruments Directive (MiFID), enacted by European Union (EU) in 2004, has three pillars: transparency, investor protection, and competition. It aims to improve availability of information to the market participants and is arguably the most far-reaching piece of legislation in the EU. In the words of Charlie McCreevy, the then European Commissioner for Internal Market and Services, "…MiFID as a whole is a ground-breaking package of measures. It will transform the landscape for the trading of securities and introduce much needed competition and efficiency throughout Europe's financial markets."[1] Motivated by its potentially significant impact on the European stock market, we seek to answer two questions. First, does the implementation of MiFID increase stock price informativeness? Second, does it improve stock liquidity?

There are several reasons why the three pillars of MiFID would influence the stock price informativeness and liquidity in the EU. The first pillar relates to improving trade transparency. Greater transparency will reduce information asymmetry by improving the speed of information transmission, and cutting information acquisition costs, particularly for the less sophisticated market participants. Increased transparency would also provide valuable information to market participants about the trading strategies of other investors. Better access to the competitors' trades will increase incorporation of firm-specific information, resulting in improved stock price informativeness. The level-playing field created by the regulation would also increase market participation leading to improved liquidity. Investor protection is the second pillar of MiFID. To mitigate investor uncertainty MiFID requires investment firms to obtain 'best execution' of

[1] See Charlie McCreevy's speech at the Institute for European Affairs, Dublin on June 30, 2006. Available at: http://europa.eu/rapid/press-release_SPEECH-06-430_en.htm

incoming market orders. Further, 'order handling rules' are designed to ensure that they are executed promptly and sequentially. Since these provisions aim to protect investors, they will be motivated to more actively participate in the market that will lead to greater price informativeness and liquidity. The third pillar, increased competition, gives investors an opportunity to trade at venues other than the organised stock exchanges. This will promote stiffer competition, consequently lowering the execution costs and increase stock price informativeness and market liquidity.

Existing literature offers evidence of positive impact of regulatory reforms in the financial markets on stock price informativeness and liquidity. Flood et al. (1999) provide evidence that greater disclosures narrow bid–ask spreads. Board and Sutcliffe (2000) show that on the London Stock Exchange, the reduction in trade reporting from 90 to 60 minutes leads to a decline in effective spreads. Jin and Myers (2006) find that countries with greater transparency have more informed stock prices. Further, Fernandes and Ferreira (2009) report implementation of insider trading regulation is associated with greater stock price informativeness. Zhao and Chung (2007) investigate the effect of implementing Security and Exchange Commission (SEC) Rule 605 on the public disclosure of execution quality on the depth and spread of AMEX, NYSE and NASDAQ stocks and find evidence of improved liquidity. Boehmer et al. (2007) examine the effect of monthly execution-quality disclosure on order-routing decisions and show that promoting public disclosure is associated with a reduction in execution costs. Cumming et al., (2011) and Christensen et al. (2016) report positive impact of stock exchange trading rules on transparency and liquidity.

However, greater transparency and increased competition can also adversely affect liquidity and stock price informativeness. First, greater transparency may diminish information

advantage of sophisticated investors, reduce their profits and disincentivise them from actively trading in the market (Rindi, 2008; Boulatov and George, 2013). Second, increased competition may lead to fragmented markets and allow "cream-skimming" by informed investors (Bessembinder and Kaufman, 1997). Further, Chowdhry and Nanda (1991) demonstrate that multiple trading venues lead to increased adverse selection costs. Thus, the contradictory evidence of the impact of securities regulations on stock price informativeness and liquidity demands a thorough investigation of MiFID's impact on the EU stock markets.

Our study makes three important contributions. First, our paper makes a novel contribution to the literature that studies the nexus of securities regulation and stock price informativeness (e.g., Boehmer et al., 2005; Fernandes and Ferreira, 2009). To the best of our knowledge, this is the first study to offer empirical evidence of the impact of MiFID regulation for the EU capital markets. More specifically, we contribute to this literature by showing that the implementation of the MiFID regulation has economically benefited the EU capital markets in terms of a substantial increase in the informativeness of stock prices. This is in line with Grossman and Stiglitz (1980) who suggest that improved transparency is associated with more informative stock prices. We show that regulatory intervention that aims to improve investor protection and market competition can contribute positively to stock price informativeness.

Second, our work supplements the stream of literature examining the relationship between stock market regulation and stock liquidity (e.g., Boehmer et al., 2005; Chung and Chuwonganant, 2009; Cumming et al., 2011, Christensen et al., 2016). Cumming et al. (2011) investigate the effects of exchange trading rules and other wider regulations like MiFID. They find that implementation of regulations improves liquidity. On the contrary, while examining impact of the Market Abuse Directive (MAD) and the Transparency Directive (TPD),

Christensen et al. (2016) find no evidence that MiFID improves liquidity. Our research design is similar to Christensen et al. (2016). However, while MiFID is just a control variable in Christensen et al. (2016), our paper is significantly different as we provide evidence of MiFID's impact on liquidity as well as stock price informativeness. Further, unlike Cumming et al. (2011), we use firm level data that is more insightful and provides a more robust evidence of MiFID's impact in the EU.[2] Our results provide direct evidence of significant stock liquidity benefits accruing from MiFID's implementation in the EU and are consistent with the theoretical model of Easley and O'Hara (2009), which suggests that increased regulatory interventions in the financial market can generate significant benefits.

Last but not the least, our paper contributes to the strand of literature on the influence of legal convergence on capital markets across EU countries (e.g., Christensen et al., 2016). Extant literature suggests that the quality of existing regulations is associated with the capital-market outcomes (e.g., Jackson and Roe, 2009; Cumming et al., 2018). We find that increase in price informativeness and liquidity is significantly higher for countries that have weaker quality of regulation. The findings imply that countries with weaker regulations benefit more in terms of improved price informativeness and liquidity.

We use monthly panel dataset with firm-level observations comprising 5,888 EU incorporated firms that have publicly traded stocks over the period January 2006 to September 2008. We employ a Difference-in-Differences (DID) research design (e.g., Fidrmuc and Hainz, 2013; Dambra et al., 2015) with country, industry, and calendar-month fixed effects. We exploit

[2] There is an ongoing debate with regard to grouping of regulations and their impact on liquidity (See Cumming and Johan, 2018). Further, Mclean et al. (2012) argue that firm level analysis is more powerful than country level analysis.

the staggered implementation of MiFID across the 28 EU countries that enables us to draw causal inferences and attenuates the effects of concurrent economic and institutional changes unrelated to the regulation (see, for example, Giroud, 2013; Christensen et al., 2016). Cumming and Johan (2018) argue that since MiFID was adopted by most of the EU countries in our sample at the same time, the staggered approach may not take into account the fall in liquidity caused by the 2008 financial crisis. Therefore, to ensure robustness, we use a control sample by matching each EU firm with a firm from the US or Canada. Our empirical results demonstrate that stock price informativeness improves significantly after the implementation of MiFID. In economic terms, post-MiFID, price informativesness improves by 3 to 14 percentage points. We also find significant increase in liquidity with the bid-ask spread declining by 60 to 100 basis points post-MiFID. Further, we show that MiFID's impact on stock price informativeness and liquidity is greater for those EU countries that have weaker regulatory environment. The evidence is consistent with Cumming et al. (2015) in that we find the regulation with enforcement improves market efficiency. Notably, endogeneity arising from reverse causality is not a concern in our study because MiFID was a part of the Financial Services Action Plan (FSAP), an EU-wide regulation. MiFID was not enacted in response to a specific event (see, Cumming et al., 2011). Further, we use Propensity Score Matching (PSM) and Difference and Differences (DID) methods which are highly effective in mitigating endogeneity concerns (Roberts and Whited, 2013).

The rest of the paper is organised as follows. Section 2 provides a discussion of relevant MiFID provisions and the related literature. Section 3 describes the data and empirical methods. Section 4 discusses the empirical findings and Section 5 concludes.

2. The regulatory environment

The MiFID Directive, a key element of the FSAP, belongs to a group of four-part regulatory reforms. The other three regulations are: the Prospectus Directive, the Market Abuse Directive, and the Transparency Directive. All these reforms relate to Level 1 framework of the Lamfalussy process which was implemented from 2001 for a more effective regulation of the EU securities markets (Cumming and Johan, 2018).[3]

Part 1, the Prospectus Directive aims to ensure that once a prospectus has been approved in one member state, it is valid to be used throughout the EU.[4] The directive is intended to enhance investor protection in the capital market through the production and issuance of a single high-quality approved prospectus.

Part 2, the Transparency Directive sets minimum mandatory disclosures of financial reports for all publicly listed companies within the EU. The main objective is to ensure transparency and eliminate adverse selection problem arising from information asymmetries between firms and investors in the capital market.[5]

Part 3, the Market Abuse Directive (MAD) aims to ensure that insider trading and market manipulation are eliminated. [6] It contains two key features: disclosure rules aimed at preventing

[3] See European Central Bank, The Governing Council Review of the Application of the Lamfalussy Framework to EU Securities Markets Legislation Contribution to the Commission's Public Consultation, 17 February 2005 at https://www.ecb.europa.eu/pub/pdf/other/lamfalussy-reviewen.pdf?f5868b90e22b00d7457ea0c2ec391299

[4] http://webarchive.nationalarchives.gov.uk/20100407164605/http://www.hm-treasury.gov.uk/d/DFE27339-BCDC-D4B3-16FD311B308ABF54.pdf

[5] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:390:0038:0057:EN:PDF

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003L0006&from=en

the informational advantage of insider and detecting market manipulation, and imposing sanctions to dissuade insider dealing and market manipulation.[7]

MiFID, passed by the EU legislature in April 2004 as regulatory harmonisation directive, concludes Part 4 of the Level 1 framework directive of Lamfalussy process.[8] It aims to foster efficiency of trading services through fair competition and greater transparency in the EU capital markets. It also intends to increase the accessibility of markets and level the playing field between the informed and uninformed investors by narrowing the information gap.[9]

To improve liquidity, market quality, and foster competition, MiFID abolishes the "concentration rule".[10] It fragments the markets into the regulated markets (RMs), the Multilateral Trading Facilities (MTFs) and the Systematic Internalisers (SIs).[11] The RMs are the traditional exchanges that bring together buyers and sellers in financial instruments through an order book or through dealers. The MTFs have similar trading functionalities to RMs but with lower regulatory requirements. Under MiFID regime, the MTFs cannot route transactions to other exchanges that have better prices because they are not classified as broker-dealers. The MTFs can be operated either by an operator of a RM or by an investment firm. The SIs are retail

[7] MiFID supports organizational agreements, real time computer surveliance, and enforces the implementation of MAD (Cumming and Johan, 2008).
[8] Directive 2004/39/EC replaces and repeals the 1993 Investment Services Directive (Directive 93/22/EEC or ISD) in its entirety.
[9] See European Commission, Directorate General Internal Market and Services, Financial Services Policy and Financial Markets, Securities Markets, 8 December 2010, Public Consultation, Review of the Markets In Financial Instruments Directive (MiFID) at http://ec.europa.eu/finance/consultations/2010/mifid/docs/consultation_paper_en.pdf
[10] The "concentration rule" required that firms execute client orders only through the primary market. Its abolition will lead to fragmentation of markets and increased competition between trading centres (e.g., Ferrarini and Wymeersch, 2006; Aitken et al., 2017).
[11] As defined in Article 4(1), (7), (14) and (15)

market makers that internalise equity trades by executing client orders on their own account outside of a regulated market or MTF.[12]

Additionally, MiFID improves transparency of the three-tiers of the market by enabling the market participants to observe information during the trading process. For the pre-trade transparency, articles 27, 29 and 44 of the directive require that current orders and quotes relating to shares should be available to the public in real time. Pre-trade information gives market participants the opportunity to monitor the conditions in the market at each price point for all securities concurrently to help them make informed trading decisions. However, MTFs have a number of waivers available to them. For example, based on order size or market model, the MTFs may only have to report executed trades.[13]

Regarding post-trade transparency, articles 28, 30, and 45 of the Directive require all market intermediaries to make public, details of executed trades as close to real time as possible with the exception of deferment of the publication of large and block trades. Further, articles 19 to 24 introduce the suitability requirements to ensure that investment and portfolio management firms act in the clients' best interests.

Further, MiFID aims to improve investor protection by requiring the investment firms to obtain "best execution". In other words, the transaction should be the best possible result given the client's stated investment objectives (Article 21). Further, Article 22 requires the investment firms to implement procedures to ensure prompt and sequential execution of orders. Article 31

[12] See Article 4(7)
[13] See Article 29.

requires investment firms to classify investors as retail, professional, and eligible counterparties with varying degrees of protection (e.g., much higher level of protection for retail investors).

3. Hypotheses development

3.1. MiFID and the stock price informativeness

Increased transparency has a positive impact on information production and aggregation, which in turn influences the degree to which security prices incorporate firm-specific information (e.g., Grossman and Stiglitz, 1980). Glosten (1999) provides anecdotal evidence that greater market transparency increases commonality of information, leading to more efficient price discovery. Easley and O'Hara (2009) argue that regulatory interventions in the financial market can encourage wider participation by mitigating investor concerns regarding ambiguous information. La Blanc and Rachlinski (2005) argue that increased market participation will lead to higher stock price informativeness because every investor will bring new information to the market. Even the pure noise traders, will improve price accuracy by providing liquidity and an opportunity for the informed investors to trade. Consistent with this view, Jin and Myers (2006) show countries with greater transparency have more informative stock prices. Similarly, Fernandes and Ferreira (2009) document that implementation of insider trading regulation is associated with increased market transparency and price informativeness. As a consequence of reduced information asymmetry and higher liquidity, individual investors produce new information and improve stock price informativeness (Wang and Zhang (2015). Finally, Boehmer et al. (2005), show that increased transparency improves pricing efficiency in NASDAQ.

On the contrary, improved transparency and lower transaction costs can reduce stock price informativeness as it attracts uninformed investors to the market. For example, Barber and Odean (2000), and Han and Kumar (2013) show that uninformed investors are influenced by fads and psychological biases and distort the informational efficiency of the market. Similarly, Barber et al (2009) argue that since retail investors are largely noise traders, they increase market volatility thereby reducing the stock price informativeness. In addition, in a recent study, Banerjee et al. (2018) argue that due to complementarity in learning, greater transparency may be counterproductive as it can make the information acquisition about other investors to be more valuable and discourage learning about asset's fundamentals, thus decreasing price informativeness.

Since the extant literature offers contradictory evidence regarding the impact of transparency related regulations on incorporation of firm specific information, MiFID's impact on stock price informativeness is not clear-cut. Therefore our first null hypothesis is:

Hypothesis 1. The implementation of MiFID will have no effect on stock price informativeness.

3.2. MiFID and liquidity

The existing evidence on the impact of disclosure related regulations on liquidity is mixed. On one hand, research has shown that improved transparency lowers information acquisition costs (Hakansson (1977) and increases liquidity (Kyle, 1985). Existing evidence suggests that transparency and fragmentation reduce transaction costs and increase trade execution speed (O'Hara and Ye, 2011), enhance trading activity (He et al., 2014), lower volatility (Boneva et al., 2016), and reduce market breakups and breakdowns (Gao and Mizrach, 2016). Consistent with this view, Boehmer et al. (2005) report improvement in liquidity and

reduction in transaction costs following the introduction of the NYSE OpenBook. Similarly, Chung and Chuwonganant (2009) show that the implementation of SuperMontage rule in the US leads to a decline in the bid-ask spreads and improvement in market liquidity. Zhao and Chung (2007) investigate the impact of the Securities and Exchange (SEC) Rule 605 on market quality and document a decline in spread and improvement in market quality, implying that greater transparency reduces execution costs and improves liquidity. Cumming et al. (2011) examine the impact of stock exchange trading rules (including MiFID) on market liquidity. They find that MiFID regulations positively affect market liquidity.

On the other hand, greater transparency can lead to lower liquidity. Fishman and Hagerty (1995) show that more disclosures can increase insiders' profitability and widen non-insiders' bid-ask spread. Bessembinder and Kaufman (1997) show that regulations which fragment markets allow "cream skimming" by informed investors and reduce liquidity. Bloomfield and O'Hara (1999) find that trade disclosures not only increase information efficiency but also increase the spread, implying a reduction in the liquidity. In another study, Madhavan et al. (2005) show that greater transparency leads to higher execution costs and increased volatility. Further, Rindi (2008) argues that increased transparency reduces participation of informed investors and thereby adversely affects liquidity. Related literature on dark pools (e.g., Boulatov and George, 2013) also suggests that compared the displayed markets, hidden orders improve liquidity and market quality. On the contrary, Gemmill (1996) and Saporta et al. (1999) investigate the impact of changes in the data publication regime such as changed timing of reporting for large block trades on the London Stock Exchange, and find no change in liquidity. Similarly, Christensen et al. (2016) do not find that MiFID improves liquidity.

Given the contrasting evidence, MiFID's effect on liquidity is not a priori obvious and hence we hypothesize:

Hypothesis 2. Implementation of MiFID will have no effect on stock liquidity.

3.3. Existing Regulatory environment and the impact of MiFID

Enforcement theory of Djankov et al. (2003) suggests that the outcome of regulatory intervention depends not only on the implementation of the new regulation but also on the existing regulatory environment. There are two strands of literature which suggest that the effects of the regulatory change on stock informativeness and liquidity could be dissimilar across countries. First, the 'catch-up' literature (e.g. Abramovitz, 1986) suggests that the effect of a new regulation should be higher in countries with relatively weaker securities regulation because they benefit from the backlog of pending regulatory policies. Further, in some countries their existing regulations may not require significant changes while more substantial changes may be required in other countries. Cumming et al. (2011), for example, point out that regulations in the London stock exchange were already similar to those under MiFID while those on the Vienna stock exchange required significant updating. Second, the 'hysteresis' literature (e.g., Bhattacharya and Daouk, 2002; Christensen et al., 2016), suggests that market, political and institutional forces which hindered prior regulation can be counter-productive for implementation of new regulation. Since the magnitude of MiFID's impact on price informativeness and liquidity could differ across countries depending on the quality of their existing regulations, we hypothesize:

Hypothesis 3. The quality of existing regulation will have no effect on the impact of MiFID on price informativeness and liquidity.

4. Sample and measurement of key variables

4.1. Sample

Our initial sample comprises all domestically incorporated and listed firms in the EU between 1st January 2006 and 30th September 2008. For the matched sample, we collect data for the listed US and Canadian firms over the same period. We use daily stock returns, end of the day bid-offer spreads, intraday high and low prices, and turnover volumes. We convert all non-Euro data in Euros using the end of day exchange rates. We collect monthly market values of equity, dividend yield and net income and convert all currency-denominated variables in Euros using the end of month exchange rates. The per capita GDP is converted using the end of quarter exchange rates. Indexes for measuring quality of regulation for countries included in our sample are collected annually. Data is collected from Datastream and Bloomberg.[14]

The sample period comprises 33 months and encompasses two sub-periods: the pre-MiFID period from the first month of 2006 to the month in which MiFID is adopted, and the post-MiFID period from the month after MiFID's adoption to the ninth month of 2008. To reduce the possible influence of small stocks, we follow Christensen et al. (2016) and exclude firms with an average equity market value of less than €4 million over the sample period. We also require our sample firms to have at least 12 months observations as well as at least one observation in both the pre- and post-MiFID periods (e.g., Jones et al., 2016; Kausar et al., 2016). Finally, we exclude all firms with missing industry classification code. Our final sample

[14] We use DataStream as a primary source of data. We supplement the bid-ask spread from Bloomberg for some European countries like Czech Republic, Latvia, Luxembourg, Romania, Slovakia, and Slovenia.

consists of 5,888 unique firms with 194,304 firm-months from the EU and 7,430 firms with 245,190 firm-months from the US and Canada.

4.2. Measurement of the variables

Our empirical approach requires the measurement of stock price informativeness, and liquidity variables. In this subsection, we discuss the main variables used in our analyses.

4.2.1. Measures of stock price informativeness

To measure price informativeness, we use three different measures of price delay suggested in Hou and Moskowitz (2005) and used in Phillips (2011), Busch and Obernberger (2016) and Jones et al. (2016). The measure uses market return as a proxy for new information and quantifies how average prices adjust to it. Therefore, in line with Busch and Obernberger (2016), we use daily returns to estimate for each firm and each month using the following market models:

$$r_{i,t} = \alpha_i + \beta_i^0 R_{m,t} + \varepsilon_{i,t} \quad \text{(Base model)} \quad (1)$$

$$r_{i,t} = \alpha_i + \beta_i^0 R_{m,t} + \sum_{n=1}^{5} \delta_i^n R_{m,t-n} + \varepsilon_{i,t} \quad \text{(Extended market model)} \quad (2)$$

where $r_{i,t}$ denotes the stock returns i on day t, $R_{m,t}$ is the market return on day t, $R_{m,t-n}$ is the market return n days prior to day t, n is the number of lag days, and $\varepsilon_{i,t}$ is the error term. As in Busch and Odernberger (2016), we use five lags of daily market returns to include all trading days for each week.

Our first proxy for price delay (D1) is the R^2 ratio that is calculated as one minus the ratio of the R^2 estimates of models 1 and 2:

$$D1 = 1 - \frac{R^2_{Base}}{R^2_{extended}} \quad (3)$$

If new information was immediately impounded into a firm's stock price, then R^2 s from equation (1) and (2) will be similar and *D1* will be close to zero. On the other hand, if there is delay in incorporation of information then R^2 from equation 2 will be much higher compared R^2 from equation 1 and *D1* will be closer to one.

The second price delay measure (D2), the Coefficient Ratio, is based on the ratio of the lag-weighted sum of absolute coefficients of lagged market returns relative to the sum of absolute coefficients all the regression coefficients. Unlike D1 which gives equal weights to all lags, D2 gives more weight to longer lags.

$$D2 = \frac{\sum_{n=1}^{5} n \times |\delta_i^n|}{|\beta_i^0| + \sum_{n=1}^{5} |\delta_i^n|} \quad (4)$$

The third delay measure (D3), the Standard Error Adjusted Coefficient Ratio, is based on the ratio of the lag-weighted sum of absolute coefficients of lagged market returns scaled by the coefficients' standard error relative to the sum of absolute coefficients all the regression coefficients scaled by the standard error (se) of the coefficients. D3 gives more weight to more precise estimates.

$$D3 = \frac{\sum_{n=1}^{5} n \times |\delta_i^n| / se(\delta_i^n)}{|\beta_i^0| / se(\beta_i^0) + \sum_{n=1}^{5} |\delta_i^n| / se(\delta_i^n)} \quad (5)$$

Lower values of the delay proxies would indicate quicker incorporation of new information in stock prices. Since the three proxies are likely to capture similar fundamental construct, aggregation will reduce the measurement errors in the individual proxies and improve the model estimates. We, therefore, perform a principal components factor analysis on the three

price delay measures to identify a more parsimonious measure of price informativeness.[15] The delay factor (DelayFac) extracted is also used as a dependent variable in the analyses.[16]

4.2.2. Measures of liquidity and transaction costs

We follow the literature and estimate stock (il)liquidity using five different proxies. The first measure, Ln(1+Bid-Ask), is bid–ask spread commonly used in literature to capture illiquidity (e.g., Cumming et al., 2011, Chung and Zhang, 2014, Christensen et al., 2016). It is defined as the difference between the daily closing bid and ask price divided by the average of bid and ask price. We use the natural log of 1 + the monthly average spread as a measure of illiquidity. Our second proxy, Ln(1+High-Low), is the high-low spread computed using two-day interval high and low prices and then taking the natural log of 1 + the monthly average (see Corwin and Schultz, 2012 for details). Schestag et al. (2016) shows that this is a better proxy of liquidity because it appropriately captures transaction costs. Our third proxy, Ln(1+Zeros), is defined as the natural log of 1 + the proportion of days with zero stock returns in a given month (Lesmond et al., 1999). This proxy has been used as a measure of illiquidity in Christensen et al. (2016). Our fourth proxy, Ln(1+ILLIQ), is the illiquidity measure for price impact, defined as the natural log of 1 + the average of the absolute daily stock return divided by trading volume. This proxy first suggested by Amihud (2002) is one of the most widely used liquidity proxies in the literature. We multiply the ratio by one million for ease of interpretation. Finally, our fifth measure of liquidity, Ln(1+CHL), is the effective spread measure suggested in Abdi and Ranaldo (2017). It is defined as natural log of 1 + the monthly mean of daily Close, High, and Low

[15] The first factor has an eigenvalue of 1.50 and other two have eigenvalues of less than one, therefore, we only use the first factor.
[16] Lang et al. (2012) and Christensen et al. (2016) use a similar approach.

(CHL) spread measure (see Appendix A for equation). We use this measure because it provides better estimate of transaction costs, especially for less liquid stocks. For all the proxies, a higher value corresponds to lower liquidity.

Since the five proxies capture similar liquidity characteristics, we once again use factor analysis and derive two composite liquidity proxies (LqFac1 and LqFac2) to reduce the differences in the relative quality of the liquidity measures, minimize estimation errors, and ensure parsimony in our analysis.[17]

4.3. The difference-in-differences approach

The DID approach requires a control sample that has not been affected by MiFID. We use two approaches to identify the control sample. First, we take advantage of the staggered implementation of MiFID across the EU (see Table 1) and use the EU firms as their own control to isolate the causal effects on stock price informativeness and liquidity (see e.g., Giroud, 2013), and Leuz and Wysocki, 2016) for similar approach).[18] Second, as there is limited variation in the implementation dates across the EU countries, we use an alternative control sample of the US and Canadian firms. Our identification strategy assumes that the EU and the US and Canadian capital markets would have a high degree of homogeneity in the absence of MiFID introduction (the parallel trends assumption). Previous research argues that developed economies like, the US, Canada and the EU share many similar institutional arrangements (La Porta et al., 2006), are subject to similar capital market regulations and environments (Bargeron et al., 2010), and

[17] We use first two factors because they have eigenvalues of 1.60 and 1.25 respectively. The other three factors have eigenvalues of less than 1.
[18] Initially all firms are in the control group. However, they move to the treatment group when the country they belong to implements MiFID (e.g., Giroud, 2013).

exposed to similar underlying economics (Gerakos et al., 2013). Further, existing literature has extensively used listed firms in the EU, Canada, and Australia as control sample for examining the effects of Sarbanes Oxley, RegFD, and the JOBS Act (Bargeron et al., 2010; Lee et al., 2014; Dambra et al., 2015).

4.4. Baseline specification and the difference-in-differences approach

We employ the DID specification in our analyses to examine MiFID's impact on stock price informativeness and liquidity. Specifically, the basic regression models are:

$$DL_{it} = \beta_0 + \beta_1 MiFID_{it} + \gamma Controls_{it} + \sum \beta_m Fixed\ Effects_t + \varepsilon_{it} \quad (6a)$$

$$DL_{it} = \beta_0 + \beta_1 EU * MiFID_{it} + \gamma Controls_{it} + \sum \beta_m Fixed\ Effects_t + \varepsilon_{it} \quad (6b)$$

where the dependent variable, DL_{it}, is one of three measures of stock price informativeness or one of the five liquidity proxies for firm i in month t. We use equation 6a for the EU only sample and equation 6b is for the matched sample. β_1 is the regression coefficient of our primary variable of interest (MiFID in equation 6a and $EU * MiFID$ in equation 6b), and is a dummy variable equal to one beginning from the month MiFID comes into force in a given EU member state and equal to zero otherwise. $Controls_t$ constitute several firm and country control variables. $Fixed\ Effects_t$ constitute country, industry, and month fixed effects to ensure robustness to heteroscedasticity as well as to account for EU-wide heterogeneity, local shocks, and other common time-varying factors that may affect both stock markets and business cycle patterns. In 6b, similar to Kausar et al., (2016), we do not include EU and MiFID since EU is absorbed by country fixed effects MiFID by time fixed effects. We double-cluster standard errors along two dimensions; month and firm to adjust for heteroscedasticity as well as cross- and serial-correlation (e.g., He et al., 2014).

We control for firm-level variables that have been shown to affect stock price informativeness and liquidity (Jin and Myers, 2006; Christensen et al., 2016). We control for the firm size (Ln_Mktcap), book-to-market ratio (BTM), natural logarithm of share turnover (LnShare_turnover), log volatility of stock returns (LnRet_volat), dividend yield (DivYield), and returns (Ret).[19] A loss indicator (Loss) equals to one if the net income before extraordinary items is negative in the last financial period and zero otherwise (Haw et al., 2012). The variable log GDP per capita (LnGDPPerCAP) controls for the level of economic development that might affect the overall efficiency of the stock market.[20]

We also include dummy variables to control for the effects of other regulatory interventions that may influence our results, namely the Transparency Directive (TPD) and Market Abuse Directive (MAD).[21] The TPD aims to improve quality of public information through monitoring and enforcing compliance with financial reporting provisions whereas the MAD is concerned with preventing insider trading and market manipulation (see Christensen et al. (2016) for a survey). Except for the dummies, regulatory quality variables, and GDPPerCAP, we winsorize the variables at the top and bottom 2% level to reduce the influence of outliers. Detailed description of the variables is provided in Appendix A.

4.5. Propensity score matching (PSM)

A potential concern with using the firms from the US and Canada as control sample is selection bias due to the differences in the treatment and control groups of firms. To mitigate this

[19] Monthly stock returns (Ret) are the cumulative of the daily stock returns for the month. Following Griffin et al. (2010), we delete single-day returns in excess of 200% to remove erroneous values.

[20] http://data.worldbank.org/data-catalog/worldwide-governance-indicators

[21] We do not control for financial crisis because it coincides with MiFID's implementation. In any case, since the financial crisis affected all the EU countries as well as US and Canada, it is unlikely to influence our DID results. Other similar studies (e.g., Christensen et al., 2016; Jones et al., 2016) also do not control for financial crisis.

bias, we identify the control sample using the Propensity Score Matching (PSM) of Rosenbaum and Rubin (1983). The PSM procedure removes observable differences between the treatment and control sample (Datta et al., 2015; Chan and Kwok, 2017; Shipman et al., 2017) enabling us to draw robust conclusions about the impact of changes due to implementation of MiFID. We generate the propensity scores using the following logistic model:

$$EUR_{it} = \beta_0 + \beta_1 Ln\_Mktcap_{it} + \beta_2 LnPrice_{it} + \beta_3 LnRet\_volat_{it} + \beta_4 LnShare\_turnover_{it} + \beta_5 BTM_{it} + \beta_6 DivYield_{it} + \beta_7 Ret_{it} + \varepsilon_{it} \quad (7)$$

Where EUR is 1 for EU firms, 0 otherwise. All other variables are defined in Appendix A.

We match each treatment observation to a control observation in the pre-MiFID implementation period (January 2006 to the month before the implementation of MiFID) with the closest propensity score without replacement (1:1 matching), and within a 0.001 caliper distance to avoid bad matches.[22]

5. Empirical results

5.1. Descriptive Statistics

Table 1 presents the distribution of the number of firms and firm-month for each of the countries in our sample. It shows the number of firms varies between 12 for Slovakia to 1700 for the UK. Further, the UK contributes approximately 29% of the observations and the three largest

[22] We would like to thank an anonymous referee for suggesting this approach. In a previous version, we matched the firms based on propensity scores in both time periods (pre- and post- MiFID implementation) following the approach used in Bliss et al. (2018), Iselin and Nicoletti (2017) and Kyung et al. (2019). The results were qualitatively the same and available from the first author.

markets in the EU (UK, France, and Germany) together contribute 53% of the sample. Most EU countries have implemented MiFID in November of 2007.

[INSERT Table 1]

Table 2 presents the results of the propensity score matching (PSM) procedure and diagnostic tests for the covariate balance between treatment and control samples. Panel A reports the logistic model estimates with robust standard errors adjusted for heteroskedasticity. The significant coefficients in column (1) confirm that the treatment and control samples are substantially different and show that matching firms on characteristics is appropriate. The p-value of χ^2 for overall model fitness is well below 0.001 indicating that our model significantly explains variations in the choice attribute.

One of the key assumptions of the DID approach is that the treatment and control groups follow a parallel trend both, before and after the treatment (MiFID implementation in our case). Similar to Fang et al. (2014), we run two diagnostic tests to check the validity of the parallel trends assumption in our data. First, we re-run the Logistic model on the matched sample to test whether the PSM is successful in achieving balance for covariates. Our findings in column (2) show that both groups have identical attributes in pre-MiFID period since the coefficients of the independent variables are not significantly different from zero, and the χ^2s are statistically insignificant.[23] In addition, smaller coefficients of firm characteristics in column (2) suggest the insignificance of the coefficients is due to removal of cross-sectional differences between the

[23] Our results also show that while the industry dummies are statistically significant before the matching, they are not significant after the matching procedure. We do not report the industry coefficients for brevity.

treatment and control firms and not because of lower degrees of freedom due to smaller sample size.

Second, panel B shows the distribution of propensity scores of the treatment and control groups is similar. In the pre-MiFID period, the maximum distance is only 0.001, and therefore trivial. Overall, the evidence from both diagnostic tests suggests that the treatment and control firms have identical firm attributes before MiFID implementation.

[INSERT Table 2]

Table 3 Panel A presents the summary statistics. The mean (median) value of delay measure (D1) obtained from Equation (3) is 0.561 (0.528), for D2 obtained from Equation (4) is 1.876 (1.877), while the value for D3 obtained from Equation (5) is 1.794 (1.606). In general, this suggests that the proxies are not skewed. The mean (median) of Ln (1+Bid-Ask) is 0.047 (0.020) and for Ln(1+High-Low) it is 0.036 (0.000). The liquidity proxy, Ln(1+Zeros) suggests that on average 17% of the total sample were non-trading days. It also reports the descriptive statistics of the control variables. The mean (median) market value is €1,245 (€76) million before logarithmic transformation, suggesting the firm size is highly skewed. As is apparent, the mean (median) monthly returns are -0.5% (-0.2%). About 23 percent of sample firm observations made a loss during these periods. The average stock has a dividend yield of 1.9% but the mean is biased upwards by several high dividend yield stocks, reflected by the median value of 0.5%. Panel B also provide summary statistics for the matched sample in the pre-MiFID period. The results of the univariate comparisons of the means of each of the matched control variables (column 13) show that the treatment and control samples are similar across variables that influence stock price informativeness and liquidity. Following Erkens et al. (2018), we report the

normalized differences in column (14). The normalized differences are calculated as the difference in average for treatment and control sample divided by the square root of the mean of the sample variances. The normalized differences are below the threshold of 0.25 (as suggested by Imbens and Wooldridge, 2009), further confirming the differences in the covariates between the two samples are insignificant. Collectively, the results suggest that the covariates are generally balanced across the matched sample.

[INSERT Table 3]

We examine the correlation for all variables (not tabulated here for brevity but available on request). None of the independent variables show high correlations suggesting that multicollinearity is not a concern. For the price delay proxies (dependant variable), two of the three delay measures show high correlations. All liquidity proxies show low correlations with the exception of the correlation between Bid-Ask spread and Amihud's illquidity factor (0.52). We conduct Principal Component Analysis (PCA) for stock price delay and liquidity proxies for parsimony. DelayFac, which is the only component (with eigenvalue > 1) of the PCA of the price delay proxies is highly correlated (80 percent and above) with D2 and D3 showing it captures the information in these two proxies. The liquidity PCA gives two components with eigenvalue > 1 (LqFac1 and LqFac2) suggesting they capture different dimensions of the information in individual proxies.

5.2. MiFID and the stock price informativeness

In this section, we examine the effects of the adoption of the MiFID directive on stock price informativeness. Table 4 presents our regression results of four different specifications of

the regression in equation (6). Panel A reports the results of each of the three proxies and the aggregate measure for the EU only firms whereas Panel B presents the results for the matched sample. The results reported in Panel A show that all specifications yield similar results i.e., the coefficient estimates of MiFID are significantly negative at the 5% level or better, indicating that the adoption of MiFID is associated with decrease in price delay and increase price informativeness. As our specification contains industry, country, and month fixed effects, and standard error double-clustered by month and firm level, the effect of MiFID appears to be economically significant. Column (1) shows that, in economic terms, a change in capital market regulation from 0 to 1 reduces Delay by 7.0 percent (=-0.039/0.561, where 0.561 is the mean delay (D1) obtained from Panel A of Table 3). In the spirit of these results, we also test whether the parsimonious measure of price delay (DelayFac) provides similar reduction in delay post-MiFID. Again, the result is qualitatively similar (see column (4) of Table 4) to the models estimated using the aggregate delay proxies. The coefficient estimate on MiFID in column (4) is negative and statistically significant at the 1% level, and it is higher when compared to columns (1) to (3). This finding indicates that: (i) price delay decreases after the adoption of MiFID; and (ii) the parsimonious measure of price informativeness also shows improvement. The results reveal that the adjusted R^2 is higher for column (4) relative to columns (1) to (3) in Panels A of Table 4, indicating that the DelayFac model specification in column (4) has greater explanatory power compared to the other specifications. Another plausible explanation could indicate that the variables D1, D2 and D3 are more noisy proxies of price delay and, therefore, may introduce attenuation bias, which likely understate our coefficient estimates. Our evidence is consistent with Cook and Tang (2010) who provide similar results regarding the impact of Regulation FD on stock price informativeness.

Next, we test the robustness of our results by using alternative control sample of the US and Canadian firms using the propensity score matching while retaining country, industry, and month fixed effects included in Panel A. We also double-cluster standard errors by month as well as by firm. The results presented in Panel B are qualitatively similar to those in Panel A. The coefficients for the primary variable of interest (EU*MiFID) in column (1) is negative and statistically significant at the 1% level (β=-0.07, t=-4.25), confirming our previous finding that MiFID is associated with higher informational efficiency of prices. The magnitude of the effects of the other price delay and aggregate measures in columns (2) to (4) are qualitatively similar to that of Panel A. The coefficient estimates on EU*MiFID are all negative and statistically significant at the 5% level or better, suggesting reduction in price delay after the implementation of the directive. From an economic perspective, our result in column (1) shows that relative to the pre-MiFID, price informativeness increases by 9.7 percent (in terms of mean firm-specific return variation (=-0.065/0.672, where 0.672 is the average of delay obtained in Panel B of Table 3). Similarly, in column (2), a change in capital market regulation from 0 to 1 is associated with a decrease in price delay by 5.5 percent.

Finally, our results are generally consistent with regard to significance of the control variables. For example, the coefficient for market capitalization (Ln_Mktcap) is negative and statistically significant at the 1% level in all eight model specifications (Panels A and B) indicating that larger firms have more informative stock prices (e.g., Hou and Moskowitz, 2005; Phillips, 2011). In addition, we observe in five of the eight specifications, delay increases and price informativeness decreases with higher stock return volatility (e.g., see Phillips, 2011; Hou and Moskowitz, 2005). BTM is negative and statistically significant in EU only sample but not significant for matched sample. We also find that higher dividend yield (DivYield) decreases

delay and increases price informativeness. The coefficient estimate of TPD is significant in half of the model specifications, indicating that TPD is likely to increase price informativeness. The coefficient estimate of MAD is positive and significant in only half of the model specifications, which suggests that the MAD regulation has had limited impact in our sample. In summary, the evidence in Table 4 rejects our hypothesis (H1) and suggests that post-MiFID, stock market price informativeness of EU firms has improved.

[INSERT Table 4]

5.3. MiFID and liquidity

In this section, we investigate whether the adoption of MiFID affects transaction costs and liquidity by estimating the following regression model in equation (6) with liquidity proxies as dependent variable.[24] Standard errors are double-clustered by month and firm dimensions.

In Panel A of Table 5, we report the regression results for the EU only firms. In terms of our key variable of interest (MiFID), the estimates are statistically significant at the 10 percent level or better and exhibit negative sign in all specifications. The evidence suggests a significant reduction in transaction costs and improvement in market liquidity post-MiFID. More specifically, column 1 reports the impact of MiFID on the bid-ask spread. The result indicates that MiFID has a negative and statistically significant effect on the bid-ask spread (β=-0.006, t= -3.47). In economic terms, the adoption of MiFID lowers bid-ask spread by 60 basis points ($=e^{-0.006}-1$) for the EU firms, indicating an increase in liquidity. Since the pre-MiFID mean is 4.5 percent, this represents a reduction of 13 percent in average spread. Similarly, using the close,

[24] The measures are defined in the appendix.

high, low spread as the dependent variable in column (5), liquidity improves by 1 basis point ($=e^{-0.001}-1$). Since the pre-MiFID average is 0.50 percent, it suggests a reduction of spread by 20 percent.

For robustness, we repeat our analysis with the matched sample. From results in panel B, we find that MiFID's impact (EU*MiFID) is negative and statistically significant at 5 percent or better in six of the seven specifications. The results are qualitatively similar to those in panel A and suggest that MiFID lowers transaction costs and improves liquidity. Specifically, in column 1, the coefficient estimate for the key variable of interest (EU*MiFID) is negative and strongly significant (β=-0.010, t= -3.95). The effect is economically large because average spread declines by 100 basis points ($=e^{-0.010}-1$) or by 24.4 percent relative to matched control firms. Overall, the empirical evidence strongly rejects our null hypothesis (H2) and suggests that the MiFID directive has reduced trading costs and improved market liquidity.

[INSERT Table 5]

5.4 Falsification tests

To further confirm the validity of our identification strategy, we conduct falsification tests by rerunning the analyses with lag-term implementation period.[25] In particular, we create three random hypothetical dummies, 1 month before ($EU*MiFID^{-1}$), 3 months before ($EU*MiFID^{-3}$), and 6 months before ($EU*MiFID^{-6}$) that indicate months before the adoption of MiFID. To satisfy the parallel trend assumption, the coefficient estimates of the lag terms should be insignificant (e.g., see Kausar et al., 2016).

[25] We thank an anonymous referee for suggesting this test.

In Table 6, we report the results with one delay measure (D1) and one liquidity measure (Ln(1+Bid-Ask)).[26] For brevity, we only tabulate the coefficient estimates and t-statistics of the key variables of interest. We note that only one of the coefficient estimates of EU*MiFID^{-1}, EU*MiFID^{-3}, and EU*MiFID^{-6} are statistically different from zero. Thus, the findings lend further support to the validity of the parallel trends assumption underlying our analysis.

[INSERT Table 6]

5.5. Regulatory quality and the impact of MiFID

Our analyses so far show that the implementation of MiFID is associated with increased stock price informativeness and liquidity. In this section, we investigate whether the heterogeneity in the regulatory quality among countries has any effect on MiFID's impact on stock price information and liquidity. Thus, to assess the quality of regulation (QltyReg) of the EU countries in our sample, we use three institutional proxies: World Bank Regulatory quality index (Estimate of Governance), World Economic Forum Global Competitiveness indexes (Strength of Investor Protection index, and Trustworthiness & Confidence index).[27] In Table 7, we present the 2006 and 2008 scores for each of the three regulatory quality indexes.

[26] Results using other proxies of stock price informativeness and liquidity are qualitatively similar and available on request.

[27] The Regulatory Quality index was first developed by Kaufmann et al. (2004) and is updated and maintained in the World Bank's Worldwide Governance Indicators database. It captures governments' ability to implement policies that promote private sector development. As Christensen et al. (2016) highlight, this indicator generally captures the benefit of past regulation (both in the capital markets and other areas). The Investor Protection index assesses the influence of country-level governance safeguards that permit and promote private sector development. It is composed of the Extent of Disclosure Index, the Extent of Director Liability Index and the Ease of Shareholder Suits Index and can be regarded as the main measure of investor protection regulations (Haidar, 2009). It is part of World Economic Forum Global Competitiveness index dataset found in the World Bank's Doing Business Reports. The Financial Market Development (Trustworthiness and Confidence) index originates from the World Economic Forum Global Competitiveness index. It measures the efficiency of supervision and regulation of stock exchanges as well as bank soundness and protection of borrowers and lenders' rights and used in Ng et al. (2015).

[INSERT Table 7]

To shed more light on the catch-up process for countries with weaker securities regulation, we use the time series of these proxies. We test our hypothesis 3 about the differential impact of the quality of pre-existing regulation on the impact of MiFID on price informativeness and liquidity using the following model:

$$DL_{it} = \beta_0 + \beta_1 EU * MiFID + \beta_2 QltyReg_{\lambda} + \beta_3 QltyReg_{\lambda} * EU * MiFID + \gamma Controls_t + \sum \beta_m Fixed\ Effects_m + \varepsilon_{it} \quad (8)$$

where DL_{it} is the dependent variables, QltyReg_{λ} is the index value or set to 1 for countries with high past regulatory quality. Our main variable of interest is the regression coefficient, β_3, which captures the incremental effect of QltyReg*EU*MiFID on price delay or liquidity proxies. All other variables are the same as defined in equation (6). Our approach is, in principle, similar to that of Cumming et al. (2011) who create indexes based on specific rules on 42 stock exchanges over time in order to capture the effect of changes in regulation.

To the extent that MiFID improves the quality of regulation and also accelerates the catch-up process by providing a level-playing field across the capital markets in the EU, the coefficient of QltyReg for member states with weaker securities regulation are likely to be higher than those with stronger securities regulation. Thus, higher values of the coefficient of the interaction term (β_3) would indicate that EU countries with past weaker regulation are catching-up with countries with stronger regulation.

Table 8 reports the regression results for stock price informativeness. For brevity, we only tabulate the coefficient estimates and t-statistics of key variables of interest. The estimated

coefficients on MiFID are significantly negative for all but one model specifications, indicating that adoption of the MiFID directive increases stock price informativeness. In column (1) of Panel A, the coefficient on the main variable of interest, QltyReg*EU*MiFID, is significantly positive (β=0.322, t=3.53), suggesting that price delay benefits of MiFID are stronger in countries where the regulatory quality is weaker. Columns (2) and (3) show a similar impact as captured by the Strength of Investor Protection index, and Trustworthiness and Confidence index. Panel B presents results for the matched sample, the evidence is qualitatively similar to panel A. We also analyse MiFID's impact using individual price informativeness proxies (not tabulated here for brevity) and find similar results. Collectively, these results suggest that MiFID's impact on stock price informativeness is higher for countries that have weaker regulatory quality. This leads us to reject our null hypothesis H3 with regard to the differential impact of MiFID on price informativeness.

[INSERT Table 8]

Next, using the same empirical approached as in Table 8, we examine the differential impact of MiFID on liquidity using the two factors (LqFac1 and LqFac2) obtained from the PCA. Panel A of Table 9 reports results for EU only countries and Panel B for the matched sample. Our results reveal that the estimated coefficients on MiFID are negative and statistically significant in all twelve model specifications (in panels A and B), suggesting that liquidity improves post-MiFID. For our primary variable of interest (QltyReg *EU*MiFID), using LqFac1 as the proxy for liquidity, the evidence shows that countries with low quality of regulation show a greater improvement in liquidity post-MiFID.[28] The results LqFac2 are similar

[28] All six coefficients are positive and four are statistically significant.

with five of the six coefficients are positive with four being statistically significant. We therefore reject our null hypothesis H3 with regard to the differential impact of MiFID on the market liquidity.

[INSERT Table 9]

6. Conclusions

MiFID aims to enhance investor protection, competition and access to information in the EU capital markets. We make important contributions to the literature on the consequences of disclosure related regulations by providing a robust evidence of the MiFID's effect on stock price informativeness. We also complement the evidence of MiFID's impact on stock market liquidity provided in a small number of related studies. Further, we show that the quality of past regulation has a significant influence on the improvements in price informativeness and liquidity following the implementation of MiFID.

Our results show that disclosure regulations such as MiFID can provide significant economic benefits through easier and cheaper access to information. We find that post-MiFID, the price informativeness significantly improves by 3 to 14 percent. Using stock level data, our results support the previous finding reported by Cumming et al. (2011) which shows that liquidity improves following the implementation of MiFID. We find that the execution costs proxied by the bid-ask spread decline by 60 to 100 basis points. We also present evidence that increase in price informativeness and liquidity is significantly higher for countries that have weaker quality of regulation. This evidence is consistent with the 'Catch-up Hypothesis' which suggests the economic benefits of new regulations are likely to be greater for countries that have weaker regulatory quality.

From a broader perspective, our evidence suggests that securities regulations with enforcement which promote transparency, improve investor protection and increase stock market competition are effective in improving market quality.

Appendix A. Variable definitions

Variables	Description
BTM	Book-to-market is the ratio of book value of equity and the monthly market value of equity.
D1	Delay (D1), is calculated as one minus the ratio of the R-Square of the base regression (equation 1) to the R-Square of the extended regression (equation 2).
D2	Delay (D2) is the ratio of the lag-weighted sum of absolute coefficients of lagged market returns relative to the sum of absolute coefficients all the regression coefficients as in equation (4).
D3	Delay (D3) is the ratio of the lag-weighted sum of absolute coefficients of lagged market returns scaled by the coefficients' standard error relative to the sum of absolute coefficients all the regression coefficients scaled by the standard error of the coefficients as in equation (5). All price delay measures have been calculated over one month.
DelayFac	DelayFac is an aggregate Delay measure and represents the scores of a first factor extracted from the three underlying proxies (D1, D2, D3) using the PCA.
DivYield	Dividend yield is the Dividend Per Share divided by the end of the month stock price.
Ln(1+Bid-Ask)	Defined as the natural log of one plus the monthly mean of the daily closing bid-ask spread scaled by the midpoint between bid and ask prices.
Ln(1+High-Low)	Natural log of one plus the monthly mean of daily High-Low measure (see Corwin and Schultz (2012) for details on the estimation).
Ln(1+Zeros)	Natural log of one plus the proportion of trading days with zero daily stock returns out of all trading days in a given month (Lesmond et al., 1999).
Ln(1+ ILLIQ)	Computed as the natural log of one plus the monthly average of the daily absolute value of stock return divided by the euro trading volume, multiplied by one million.
Ln(1+CHL)	Natural log of one plus the monthly mean of daily Close, High, and Low (CHL) spread measure: $CHL = \sqrt{E[(c_t - \eta)(c_t - \eta_{t+1})}$ Where c is the daily close log-price and η is midpoint of daily high and low log-prices (see Abdi and Ranaldo, 2017).
Ln_Mktcap	Natural log of stock price times the number of shares outstanding measured at the end of the month (in millions of euros).
LnGDPPerCAP	Natural log of quarterly Gross Domestic Product Per Capita.
LnShare_turnover	Natural log of the monthly mean of the daily turnover (i.e., trading volume in euros divided by the market value at the end of each trading day).
LnPrice	Natural log of stock price at the end of the month.
LnRet_volat	Natural log of the standard deviation of daily stock returns in a given month.

Loss	A dummy variable that equals one if the net income before extraordinary items is negative in the last financial period and zero otherwise.
LqFac1	The liquidity factor is an aggregate liquidity measure and represents the first factor obtained from the PCA with the five liquidity variables.
LqFac2	The liquidity factor is an aggregate liquidity measure and represents the second factor obtained from the PCA with the five liquidity variables.
MAD	A dummy variable equal to one for periods after the implementation of the Market Abuse Directive.
MiFID	A dummy variable equal to one for periods after the implementation of the Markets in Financial Instruments Directive.
Regulatory Quality	Measures ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Lower scores represent lower regulatory quality. The index was first developed by Kaufmann et al. (2004) and is updated. Sourced from World Bank's Worldwide Governance Indicators database.
Strength of Investor Protection	An index aggregating the Extent of Disclosure Index, the Extent of Director Liability Index and the Ease of Shareholder Suits Index. Lower scores represent lower investor protection. Sourced from World Economic Forum Global Competitiveness index dataset in the World Bank's Doing Business database.
TPD	A dummy variable equal to one for periods after the implementation of the Transparency Directive.
Ret	Ret is the continuously compounded monthly stock return. Single-day returns in excess of 200% are deleted to remove erroneous values (Griffin et al., 2010)
Trustworthiness & Confidence	Measures the effective regulation and supervision of the financial market to protect investors. Sourced from World Economic Forum Global Competitiveness index (8 Pillar: Financial Market Development (Trustworthiness & Confidence)).

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Table 1: Sample composition and entry-into-force dates of MiFID

Country	Unique Firms	Firm-Months	MiFID entry-into-force Dates*
Austria	94	3,102	November, 2007
Belgium	143	4,719	November, 2007
Bulgaria	16	528	November, 2007
Cyprus	89	2,937	November, 2007
Czech Republic	15	495	July, 2008
Denmark	178	5,874	November, 2007
Estonia	15	495	November, 2007
Finland	131	4,323	November, 2007
France	810	26,730	November, 2007
Germany	622	20,526	November, 2007
Greece	245	8,085	November, 2007
Hungary	32	1,056	December, 2008
Ireland	41	1,353	November, 2007
Italy	272	8,976	November, 2007
Latvia	13	429	May, 2007
Lithuania	40	1,320	November, 2007
Luxembourg	15	495	November, 2007
Malta	13	429	November, 2007
Netherlands	119	3,927	November, 2007
Norway	214	7,062	November, 2007
Poland	277	9,141	May, 2008
Portugal	51	1,683	November, 2007
Romania	148	4,884	February, 2007
Slovakia	12	396	November, 2007
Slovenia	50	1,650	August, 2007
Spain	151	4,983	February, 2008
Sweden	382	12,606	November, 2007
United Kingdom	1,700	56,100	November, 2007
	5,888	194,304	
Additional control sample			
Canada	1,573	51,909	N/A
United States	5,857	193,281	N/A
	7,430	245,190	
Total	**13,318**	**439,494**	

*Source: EC (2011)[29]

[29] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011SC1126&rid=1

Table 2: Propensity score matching

Panel A: Logistic Regression

Column	**(1)**	**(2)**
Dependent variable	Prematch	Postmatch
Ln_Mktcap	0.110***	-0.001
	[34.38]	[-0.33]
LnRet_volat	-0.923***	0.001
	[-111.76]	[0.11]
LnPrice	-0.365***	0.006
	[-104.20]	[1.49]
Ret	-0.029***	-0.001
	[-2.98]	[-0.08]
LnShare_turnover	-0.274***	0.003
	[-92.06]	[0.96]
BTM	0.006***	0.000
	[4.22]	[-0.32]
DivYield	3.627***	-0.198
	[14.25]	[-1.08]
Constant	-4.136***	0.032
	[-156.47]	[1.06]
Number of observations	295,136	163,674
Pseudo R^2	0.171	0.001
p-value of χ^2	<0.001	0.689
Industry Fixed Effects	Yes	Yes

Panel B: Estimated Propensity Score Distributions

Pre-MiFID

Propensity Scores	No of Obs.	Min	P25	P50	P75	Max	STD
Treatment	81,837	0.025	0.276	0.483	0.567	0.940	0.183
Control	81,837	0.024	0.275	0.483	0.565	0.934	0.183
Difference	-	0.000	0.000	0.000	0.000	0.001	0.000

Panel A presents logistic regression estimates. The dependant variable is 1 if it is an EU firm and 0 otherwise. Column (1) reports the Pre-match coefficient estimates across sample period from January 2006 to period prior MiFID implementation while column (2) reports the post-match coefficients for the same period. The z-statistics are in brackets. All variables are defined in appendix A. All variables are winsorized at the 1st and 99th percentiles. Robust standard errors adjusted for heteroscedasticity. ***, and ** indicate 1% and 5% significance level for statistical significance.

Table 3: Summary statistics

Panel A: EU Firms only

	N	Q1	Mean	Median	Q3	Std. Dev.
Dependent variables:						
Price Delay proxies:						
D1	169,414	0.361	0.561	0.528	0.814	0.268
D2	169,414	1.545	1.876	1.877	2.224	0.522
D3	169,414	1.150	1.794	1.606	2.319	0.848
DelayFac	167,336	-0.907	0.000	-0.137	0.925	1.000
Liquidity proxies:						
Ln(1+Bid-Ask)	163,703	0.007	0.047	0.020	0.051	0.075
Ln(1+High-Low)	183,805	0.000	0.036	0.000	0.073	0.114
Ln(1+Zeros)	172,618	0.000	0.170	0.095	0.268	0.195
Ln(1+ ILLIQ)	175,002	0.004	0.383	0.052	0.348	0.768
Ln(1+CHL)	191,367	0.000	0.005	0.003	0.007	0.006
LqFac1	160,920	-0.755	0.000	-0.455	0.221	1.000
LqFac2	160,920	-0.663	0.000	-0.134	0.526	1.000
Independent variables:						
Market value (€'M)	191,367	21	1,245	76	407	4,419
LnRet_volat	179,236	-4.348	-3.929	-3.892	-3.457	0.749
Ret	191,367	-0.058	-0.005	-0.002	0.045	0.122
LnShare_turnover	174,075	-8.303	-7.134	-6.966	-5.753	1.911
BTM	174,962	0.282	0.622	0.488	0.800	0.588
LnGDPPerCaP	191,367	8.893	8.841	8.934	8.974	0.480
Loss	191,367	0.000	0.229	0.000	0.000	0.420
DivYield (%)	183,466	0.000	0.019	0.005	0.025	0.101

Panel B: Treatment and control groups matched sample (Pre-MiFID)

	Treatment						Control							
	N	Q1	Mean	Median	Q3	Std. Dev.	N	Q1	Mean	Median	Q3	Std. Dev.	Diff. in Mean	Norm. Difference
Column	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**
Dependent variables:														
D1	70,980	0.472	0.672	0.743	0.909	0.268	72,440	0.429	0.645	0.705	0.896	0.276	0.027***	
D2	81,300	1.682	2.003	1.987	2.316	0.465	81,582	1.651	1.995	1.978	2.327	0.485	0.008***	
D3	81,300	1.570	2.075	2.058	2.556	0.680	81,582	1.745	2.192	2.179	2.623	0.615	-0.117***	
DelayFac	70,517	-0.670	0.070	0.040	0.773	1.002	72,212	-0.535	0.172	0.135	0.848	0.967	-0.103***	
Ln(1+Bid-Ask)	65,554	0.006	0.031	0.014	0.034	0.049	66,312	0.001	0.029	0.007	0.031	0.054	0.002***	
Ln(1+High-Low)	80,054	0.018	0.064	0.069	0.111	0.187	80,332	0.048	0.114	0.081	0.146	0.227	-0.049***	
Ln(1+Zeros)	81,837	0.000	0.154	0.087	0.223	0.184	81,837	0.000	0.041	0.000	0.000	0.106	0.113***	
Ln(1+ ILLIQ)	81,814	0.002	0.288	0.027	0.202	0.672	81,794	0.000	0.407	0.022	0.305	0.863	-0.119***	
Ln(1+CHL)	66,343	0.002	0.006	0.005	0.008	0.005	64,251	0.005	0.011	0.008	0.014	0.010	-0.005***	
LqFac1	60,857	-0.503	-0.118	-0.454	-0.178	0.835	61,026	-0.508	0.009	-0.459	-0.076	1.051	-0.127***	
LqFac2	60,857	-0.372	-0.146	-0.136	0.062	0.840	61,026	-0.224	0.116	-0.050	0.310	1.068	-0.262***	
Independent variables:														
Ln_Mktcap	81,837	3.301	4.913	4.620	6.323	2.110	81,837	3.319	4.902	4.639	6.330	2.120	0.011	-0.06
LnRet_volat	81,837	-4.185	-3.803	-3.830	-3.294	0.587	81,837	-4.190	-3.801	-3.835	-3.305	0.751	-0.002	0.04
LnPrice	81,837	0.893	1.963	2.020	3.020	1.779	81,837	0.901	1.954	2.028	3.023	1.913	0.009	0.08
Ret	81,837	-0.049	0.002	0.001	0.067	0.236	81,837	-0.055	-0.001	-0.001	0.061	0.480	0.003	0.05
LnShare_turnover	81,837	-7.629	-6.692	-6.507	-5.408	1.878	81,837	-7.630	-6.694	-6.504	-5.412	2.156	0.002	-0.05
BTM	81,837	0.206	0.581	0.439	0.690	2.345	81,837	0.214	0.585	0.436	0.684	4.374	-0.004	0.03
DivYield (%)	81,837	0.000	0.010	0.002	0.022	0.025	81,837	0.000	0.011	0.000	0.018	0.033	-0.001	-0.02
LnGDPPerCaP	81,837	8.866	8.834	8.934	8.991	0.494	81,837	9.104	9.136	9.138	9.175	0.078	-0.302***	-0.21
Loss	81,837	0.000	0.226	0.000	0.000	0.421	81,837	0.000	0.298	0.000	1.000	0.477	0.072**	0.16

Panel A presents the summary statistics for the EU firms. Panel B presents the summary statistics for matched treatment and control sample along with the difference in means between two groups tested for significance using a two-tailed t-test. The price delay factor (DelayFac) is the aggregation of the three delay measures using principal component analysis with varimax rotation. LqFac1 and LqFac2 are the first two components obtained from the PCA of the five liquidity proxies. All variables (except DelayFac, LqFac1, LqFac2, LnGDPPerCAP and dummy variable) are winsorized at the 1st and 99th percentile and are as defined in Appendix A. The sample period is from January 2006 to the month before MiFID implementation.

Table 4: Effect of MiFID on Stock price informativeness

Panel A: EU only sample

	D1	D2	D3	DelayFac
Column	**(1)**	**(2)**	**(3)**	**(4)**
MiFID	-0.039***	-0.059**	-0.170**	-0.262***
	[-3.26]	[-2.29]	[-2.59]	[-3.31]
Ln_Mktcap	-0.021***	-0.026***	-0.118***	-0.161***
	[-19.12]	[-16.51]	[-34.11]	[-36.49]
LnRet_volat	0.019***	0.205***	0.066***	0.177***
	[4.26]	[30.65]	[3.18]	[6.45]
Ret	0.041***	0.249***	0.256***	0.394***
	[3.57]	[5.48]	[3.37]	[6.45]
LnShare_turnover	-0.002*	0.020***	-0.027***	-0.022***
	[-2.03]	[13.66]	[-4.46]	[-3.05]
BTM	-0.007***	-0.003	-0.015*	-0.034***
	[-3.20]	[-0.49]	[-1.79]	[-2.78]
LnGDPPerCAP	-0.007	-0.159	0.071	0.003
	[-0.05]	[-0.86]	[0.10]	[0.00]
Loss	-0.005	0.040***	-0.044***	-0.036**
	[-1.55]	[9.74]	[-4.14]	[-2.42]
DivYield	-0.357***	-0.002	-0.663**	-1.537***
	[-4.20]	[-0.02]	[-2.22]	[-3.32]
TPD	-0.029***	-0.002	-0.100**	-0.161***
	[-3.34]	[-0.24]	[-2.36]	[-2.79]
MAD	0.021	0.056**	0.071	0.124
	[0.63]	[2.65]	[0.28]	[1.25]
Number of observations	146,405	156,182	155,685	145,972
Adj. R-squared (%)	22.9	27.3	30.7	33.0
Effects on Delays (%)	7.0	3.1	9.5	14.0
Month fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes

This table reports the effects of MiFID on stock price informativeness. The dependent variables are the proxies for price delay. All the variables are as defined in appendix A. The regressions include (but are not reported here) a constant term. Standard errors are double-clustered by month and firm and are robust to heteroscedasticity and serial correlation. All variables (except DelayFac, LnGDPPerCAP and dummy variable) are winsorized at the 1st and 99th percentiles. The sample period is from January 2006 to September 2008. The t-statistics are reported in brackets below their coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively (two-tailed).

Panel B: Matched sample

	D1	D2	D3	DelayFac
Column	**(1)**	**(2)**	**(3)**	**(4)**
EU*MiFID	-0.065***	-0.111**	-0.256***	-0.236***
	[-4.25]	[-2.70]	[-4.42]	[-4.42]
Ln_Mktcap	-0.029***	-0.072***	-0.107***	-0.098***
	[-5.10]	[-9.09]	[-5.05]	[-5.05]
LnRet_volat	-0.034***	0.123***	-0.127***	-0.117***
	[-5.38]	[9.57]	[-5.35]	[-5.35]
Ret	0.042*	0.184***	0.156*	0.144*
	[1.81]	[4.22]	[1.81]	[1.81]
LnShare_turnover	-0.011***	-0.016***	-0.040***	-0.037***
	[-5.43]	[-3.59]	[-5.45]	[-5.45]
BTM	0.003*	-0.006	0.009	0.008
	[1.70]	[-1.62]	[1.56]	[1.56]
LnGDPPerCAP	-0.321***	-0.416	-1.183***	-1.091***
	[-2.82]	[-1.56]	[-2.75]	[-2.75]
Loss	-0.001	0.048***	-0.005	-0.005
	[-0.51]	[6.43]	[-0.52]	[-0.52]
DivYield	-0.011***	-0.015***	-0.040***	-0.037***
	[-6.23]	[-6.60]	[-6.07]	[-6.07]
TPD	0.020**	0.019	0.069*	0.064*
	[2.05]	[0.84]	[1.95]	[1.95]
MAD	0.110***	0.071*	0.422***	0.389***
	[5.29]	[1.86]	[5.28]	[5.28]
Number of observations	258,969	257,080	256,441	256,441
Adj. R-squared (%)	12.0	22.1	12.0	12.0
Effects on Delays (%)	9.7	5.5	12.3	11.4
Month fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes

This table reports the effects of MiFID on stock price informativeness. The dependent variables are the proxies for price delay. All the variables are as defined in appendix A. The regressions include (but are not reported here) a constant term. Standard errors are double-clustered by month and firm and are robust to heteroscedasticity and serial correlation. All variables (except DelayFac, LnGDPPerCAP and dummy variable) are winsorized at the 1st and 99th percentiles. The sample period is from January 2006 to September 2008.The t-statistics are reported in brackets below their coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively (two-tailed).

Table 5: Effect of MiFID on liquidity

Panel A: EU only sample

	Ln(1+Bid-Ask)	Ln(1+High-Low)	Ln(1+Zeros)	Ln(1+ILLIQ)	Ln(1+CHL)	LqFac1	LqFac2
Column	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
MiFID	-0.006***	-0.010**	-0.013*	-0.093**	-0.001*	-0.151***	-0.121**
	[-3.47]	[-1.82]	[-1.87]	[-2.15]	[-1.85]	[-2.74]	[-2.12]
Ln_Mktcap	-0.012***	0.004***	-0.008***	-0.113***	0.000*	-0.235***	0.026***
	[-23.34]	[7.13]	[-6.95]	[-24.16]	[-1.88]	[-29.24]	[5.13]
LnRet_volat	0.010***	0.020***	-0.001	0.110***	0.001***	0.208***	0.321***
	[11.60]	[12.98]	[-0.49]	[13.48]	[18.82]	[15.05]	[16.40]
Ret	0.020***	-0.003	-0.007	0.200***	0.001***	0.317***	0.160***
	[4.26]	[-0.46]	[-1.12]	[5.28]	[3.43]	[4.69]	[2.89]
LnShare_turnover	-0.007***	0.004***	-0.004***	-0.092***	0.000***	-0.150***	0.040***
	[-19.35]	[7.20]	[-3.76]	[-23.66]	[5.53]	[-23.30]	[7.47]
BTM	0.003*	0.003	-0.006	0.056***	0.000**	0.070**	0.036*
	[2.01]	[1.51]	[-1.65]	[4.30]	[2.16]	[2.63]	[1.69]
LnGDPPerCAP	-0.029	-0.024	-0.006	-0.289	0.004*	-0.283	-0.052
	[-1.44]	[-0.51]	[-0.09]	[-1.00]	[1.94]	[-0.69]	[-0.10]
Loss	0.008***	0.017***	0.010**	0.034***	0.001***	0.126***	0.138***
	[5.75]	[5.30]	[2.39]	[2.48]	[7.56]	[5.14]	[6.21]
DivYield	-0.073***	-0.166***	-0.115	-0.120	-0.003**	-0.935**	-1.157***
	[-3.02]	[-4.46]	[-1.40]	[-0.50]	[-2.09]	[-2.15]	[-3.09]
TPD	0.000	-0.002	-0.002	-0.009	0.000**	-0.043**	0.011
	[-0.44]	[-1.04]	[-0.54]	[-0.76]	[2.16]	[-2.81]	[0.52]
MAD	-0.004	0.025***	-0.023***	-0.193***	0.001***	-0.216***	0.247***
	[-1.55]	[3.53]	[-2.74]	[-4.78]	[4.01]	[-3.73]	[3.96]
No of observations	154,433	163,998	156,685	165,720	165,723	144,854	144,854
Adj. R-squared (%)	37.8	6.7	22.8	33.1	21.2	44.2	24.5
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table reports the effects of MiFID on liquidity. The dependent variables are proxies for liquidity. All variables are as defined in appendix A. The regressions include (but are not reported here) a constant term. Estimated standard errors are doubled-clustered by firm and month and are robust to heteroscedasticity and serial correlation. All variables (except LqFac1, LqFac2, LnGDPPerCAP and dummy variable) are winsorized at the 1st and 99th percentiles. The sample period is from January 2006 to September 2008.The t-statistics are reported in brackets below their coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively (two-tailed).

Panel B: Matched sample

	Ln(1+Bid-Ask)	Ln(1+High-Low)	Ln(1+Zeros)	Ln(1+ILLIQ)	Ln(1+CHL)	LqFac1	LqFac2
Column	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
EU*MiFID	-0.010***	-0.063***	-0.008	-0.102***	-0.003***	-0.178***	-0.078**
	[-3.95]	[-7.10]	[-1.61]	[-3.69]	[-3.82]	[-4.57]	[-2.37]
Ln_Mktcap	-0.013***	-0.004***	-0.003***	-0.172***	-0.001***	-0.183***	-0.027***
	[-16.68]	[-3.66]	[-7.36]	[-13.31]	[-13.44]	[-16.94]	[-7.12]
LnRet_volat	0.008***	0.041***	0.000	0.103***	0.003***	0.133***	-0.001
	[7.62]	[13.90]	[0.46]	[5.65]	[12.20]	[10.63]	[-0.24]
Ret	0.042***	0.059***	-0.003	0.698***	0.005***	0.594***	-0.027
	[11.95]	[10.75]	[-1.12]	[12.41]	[12.67]	[12.81]	[-1.06]
LnShare_turnover	-0.008***	0.003***	-0.000	-0.115***	-0.000***	-0.096***	-0.003
	[-24.46]	[4.09]	[-1.14]	[-29.05]	[-6.14]	[-22.80]	[-0.93]
BTM	-0.006***	-0.017***	-0.001	-0.064***	-0.001***	-0.087***	-0.012
	[-5.49]	[-5.42]	[-0.66]	[-4.14]	[-6.30]	[-5.46]	[-1.04]
LnGDPPerCAP	0.036***	0.161***	-0.058	0.656***	0.019***	0.499***	-0.478
	[3.03]	[3.76]	[-1.62]	[5.45]	[5.19]	[2.91]	[-1.14]
Loss	0.005***	0.043***	0.007***	-0.004	0.002***	0.081***	0.058***
	[4.37]	[9.81]	[4.66]	[-0.26]	[15.86]	[5.06]	[3.94]
DivYield	-0.002***	-0.002***	-0.001***	-0.030***	-0.000***	-0.025***	-0.009***
	[-7.48]	[-3.54]	[-3.48]	[-7.11]	[-2.94]	[-7.15]	[-3.33]
TPD	-0.001	-0.002	-0.004	0.007	-0.000	-0.001	-0.027
	[-0.64]	[-0.44]	[-1.45]	[0.50]	[-1.08]	[-0.02]	[-1.31]
MAD	-0.015***	-0.003	-0.004	-0.381***	-0.002***	-0.134**	-0.061
	[-3.97]	[-0.27]	[-0.56]	[-5.10]	[-2.96]	[-2.69]	[-0.88]
No of observations	247,048	273,252	279,808	279,742	246,728	213,994	213,994
Adj. R-squared (%)	34.8	7.7	29.5	36.9	31.0	36.0	30.0
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The dependent variables are proxies for liquidity. All variables are as defined in appendix A. The regressions include (but are not reported here) a constant term. Estimated standard errors are doubled-clustered by firm and month and are robust to heteroscedasticity and serial correlation. All variables (except LqFac1, LqFac2, LnGDPPerCAP and dummy variable) are winsorized at the 1st and 99th percentiles. The sample period is from January 2006 to September 2008. The t-statistics are reported in brackets below their coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively (two-tailed).

TABLE 6: Falsification tests for the effect of MiFID on price informativeness and liquidity

Panel A	Price Informativeness		
	EU*MiFID^{-1}	EU*MiFID^{-3}	EU*MiFID^{-6}
	D1	**D1**	**D1**
EU*MiFID	0.025	0.036	0.050**
	[0.71]	[1.18]	[2.40]
Control Variables	YES	YES	YES
Observations	258,969	258,969	258,969
Adj. R-squared (%)	11.9	11.9	12.0
Month fixed effects	YES	YES	YES
Industry fixed effects	YES	YES	YES
Country fixed effects	YES	YES	YES

Panel B	Liquidity		
	EU*MiFID^{-1}	EU*MiFID^{-3}	EU*MiFID^{-6}
	Ln(1+Bid-Ask)	**Ln(1+Bid-Ask)**	**Ln(1+Bid-Ask)**
EU*MiFID	-0.000	-0.001	-0.001
	[-0.56]	[-1.11]	[-0.57]
Control Variables	YES	YES	YES
Observations	247,048	247,048	247,048
Adj. R-squared (%)	34.8	34.8	34.8
Month fixed effects	YES	YES	YES
Industry fixed effects	YES	YES	YES
Country fixed effects	YES	YES	YES

NOTES: This table presents the results from falsification tests of regressing delay measure (D1) in Panel A and liquidity proxy (Ln(1+Bid-Ask)) in Panel B using hypothetical event dates EU*MiFID^{-1} , EU*MiFID^{-3} , and EU*MiFID^{-6} (i.e., one month, three months and six months before the actual implementation of MiFID regulation) as MiFID implementation dates. The regressions include (but are not reported here) a constant term and control variables used in model 1 (not reported here for brevity), and are estimated by difference-in-differences model with standard errors that are robust to heteroscedasticity and double-clustered by month and firm. Matched sample analysis is based on: firm size (Ln_Mktcap), log closing price (Ln_Price), log stock return volatility (LnRet_volat), natural logarithm of trading volume (LnShare_turnover), book-to-market (BTM), Dividend yield (DivYield), and returns (Ret). The t-statistics are reported in brackets below their coefficient estimates. Estimated standard errors are doubled-clustered by firm and month and are robust to heteroscedasticity and serial correlation. All variables (LnGDPPerCAP and dummy variable) are winsorized at the 1st and 99th percentiles. The t-statistics are reported in brackets below their coefficient estimates. Statistical significance denoted as ***, **, and * for 1%, 5% and 10% respectively (using a two-sided test).

Table 7: Regulatory quality of the sample countries

Countries	Regulatory Quality		Strength of Investor Protection		Trustworthiness & Confidence	
Austria	1.64	(1.61)	3.70	(4.00)	5.29	(5.32)
Belgium	1.33	(1.41)	7.00	(7.00)	5.31	(5.44)
Bulgaria	0.60	(0.70)	6.00	(6.00)	4.87	(4.58)
Cyprus	1.28	(1.37)			5.85	(5.55)
Czech republic	1.11	(1.16)	5.00	(5.00)	4.98	(5.09)
Denmark	1.80	(1.87)	6.30	(6.30)	5.99	(6.21)
Estonia	1.29	(1.42)	6.00	(6.00)	4.84	(5.11)
Finland	1.60	(1.61)	5.70	(5.70)	5.57	(5.68)
France	1.24	(1.28)	5.30	(5.30)	4.71	(5.66)
Germany	1.57	(1.49)	5.00	(5.00)	6.02	(5.9)
Greece	0.86	(0.88)	3.00	(3.00)	4.33	(4.57)
Hungary	1.21	(1.20)	4.30	(4.30)	5.10	(4.97)
Ireland	1.84	(1.91)	8.30	(8.30)	6.30	(6.06)
Italy	0.98	(0.97)	5.00	(5.70)	4.11	(4.24)
Latvia	1.00	(1.02)	5.70	(5.70)	5.75	(5.44)
Lithuania	0.97	(1.12)	5.30	(5.00)	4.54	(4.88)
Luxembourg	1.67	(1.66)		(4.30)	6.75	(5.72)
Malta	1.12	(1.20)			6.44	(6.11)
Netherlands	1.68	(1.78)	4.70	(4.70)	5.92	(5.91)
Norway	1.22	(1.37)	6.70	(6.70)	5.58	(5.69)
Poland	0.73	(0.83)	5.70	(6.00)	4.14	(4.43)
Portugal	1.07	(1.10)	6.00	(6.00)	4.84	(4.96)
Romania	0.46	(0.58)	5.70	(6.00)	4.28	(4.95)
Slovakia	1.13	(1.12)	4.30	(4.70)	6.28	(5.73)
Slovenia	0.80	(0.83)	5.70	(6.30)	5.03	(4.94)
Spain	1.18	(1.25)	5.00	(5.00)	5.27	(5.39)
Sweden	1.44	(1.64)	4.30	(5.70)	5.59	(5.86)
United kingdom	1.84	(1.79)	8.00	(8.00)	6.92	(6.19)
Canada	1.56	(1.65)	8.30	(8.30)	5.97	(5.88)
United States	1.64	(1.53)	8.30	(8.30)	5.82	(5.65)

The table presents the country scores on the four indexes as of 2006 (2008) used to measure the quality of existing regulation. Higher values imply better regulatory quality. The Regulatory Quality index was first developed by Kaufmann et al. (2004) and is updated and maintained in the World Bank's Worldwide Governance Indicators database. The Investor Protection index is part of World Economic Forum Global Competitiveness index dataset found in the World Bank's Doing Business Reports. The Trustworthiness and Confidence index originates from the World Economic Forum Global Competitiveness index.

Table 8: The effect of MiFID on stock price informativeness when existing regulation differs

	Regulatory Quality	Investor Protection	Trustworthiness & confidence
Column	**(1)**	**(2)**	**(3)**
Panel A: EU Countries only: DelayFac as dependent Variable			
MiFID	-0.241**	-0.766***	0.993***
	[-2.57]	[-6.04]	[6.59]
QltyReg	0.074***	-0.047***	-0.122***
	[2.87]	[-5.53]	[-6.70]
QltyReg*MiFID	0.215*	0.117***	0.171***
	[2.01]	[5.95]	[6.15]
Panel B: PSM matched sample: DelayFac as dependent Variable			
EU*MiFID	-0.749***	-0.907***	-1.597***
	[-4.86]	[-4.75]	[-6.68]
QltyReg	-0.236	-0.152***	-0.100**
	[-1.69]	[-3.89]	[-2.15]
QltyReg*EU*MiFID	0.322***	0.106***	0.236***
	[3.53]	[3.94]	[6.03]
Controls	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes

The dependent variable DelayFac is the first factor obtained from PCA with the three delay proxies and represents the aggregate price informativeness. All variables are as defined in appendix A. All the controls used in Table 4 are included here but not reported for brevity. The regressions include (but are not reported here) a constant term. The sample period is from January 2006 to September 2008. The t-statistics are reported in brackets below their coefficient estimates. Standard errors are double-clustered by month and firm and are robust to heteroscedasticity, cross- and serial- correlation. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively (two-tailed).

Table 9: The effect of MiFID on liquidity when prior regulation differs

	Regulatory Quality	Investor Protection	Trustworthiness & confidence
Column	**(1)**	**(2)**	**(3)**
Panel A: EU Countries only: LqFac1 as dependent Variable			
MiFID	-0.317***	-0.223**	-0.501***
	[-4.27]	[-3.01]	[-3.76]
QltyReg	0.031	-0.016	-0.030
	[0.32]	[-0.93]	[-1.11]
QltyReg*MiFID	0.132***	0.022*	0.071**
	[3.61]	[1.86]	[3.12]
LqFac2 as dependent Variable			
MiFID	-0.219**	-0.562***	0.239*
	[-2.07]	[-4.41]	[1.95]
QltyReg	0.785***	0.157***	-0.091**
	[3.76]	[4.76]	[-2.46]
QltyReg*MiFID	0.076	0.071***	-0.056**
	[1.45]	[3.26]	[-2.59]
Panel B: PSM matched sample: LqFac1 as dependent Variable			
EU*MiFID	-0.136**	-0.105**	-0.559***
	[-2.58]	[2.14]	[-6.77]
QltyReg	-0.206***	-0.052***	0.042**
	[-3.50]	[-4.39]	[2.15]
QltyReg*EU*MiFID	0.041	0.007	0.087***
	[1.33]	[0.98]	[6.40]
LqFac2 as dependent Variable			
EU*MiFID	-0.070***	-0.079***	-0.103***
	[-5.42]	[-5.41]	[-4.48]
QltyReg	-0.035*	-0.001	-0.005
	[-1.95]	[-0.16]	[-1.31]
QltyReg*EU*MiFID	0.022***	0.007***	0.012***
	[2.95]	[3.27]	[3.05]
Controls	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes

The dependent variables LqFac1 and LqFac2 are the first and second factors obtained from PCA with the five liquidity proxies and represents the aggregate liquidity measure. All the controls used in Table 4 are included here but not reported for brevity. All variables are as defined in appendix A. The regressions include a constant term (but not reported here). The sample period is from January 2006 to September 2008. The t-statistics are in brackets. Standard errors are double-clustered by month and firm and are robust to heteroscedasticity, cross- and serial- correlation. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively (two-tailed).