Regulation and stock market quality:
The impact of MiFID II on liquidity and efficiency of European stocks

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Abstract

This paper investigates the effects produced by the unbundling of analyst research costs required by MiFID II on market quality, as measured by stock liquidity and price efficiency. Our findings suggest that the unbundling of research costs brought a reduction in the production of analyst reports, and negatively affected stock liquidity and price efficiency. Based on a sample of more than 2,000 European stocks we find a decrease in analyst coverage for both small and large cap stocks, an increase in bid-ask spread and a deterioration in price efficiency for the entire sample. We double checked our results with a difference-in-difference research design, using both an unmatched and a matched-sample. [We are currently expanding our data set with the inclusion of up to 4,100 additional firms for the control sample in the difference-in-difference approach. Our plan is to incorporate the results based on the expanded data set in a new version by May 2020]

Keywords: MiFID II; analyst coverage; sell-side research; liquidity; price efficiency

JEL Classification Codes: G14, G24, G28

1. Introduction

The new directive on markets in financial instruments (MiFID II), approved in May 2014, is in effect from 3 January 2018. Together with other relevant changes for EU financial markets, MiFID II requires unbundling and separate pricing for analyst research. Prior to January 2018 sell-side analyst research was freely distributed to buy-side clients, whereas with MiFID II in place sell-side research is to be sold to buy-side asset management firms through specific agreements, driving to potentially severe research's budget reductions for sell-side brokerage firms. Although the purpose of the unbundling is to promote transparency into the commission fee structure this innovation may also lead to unintended consequences[1].

A vivid debate is currently ongoing on the effects of this provision. According to a survey realized by CFA Institute (2019) about the impact of MiFID II on costs, quality and investment research coverage, independent research providers have not benefitted from the new directive, as 57 percent of buy-side respondents report sourcing less research from investment banks than before MiFID II. The survey also presents mixed results regarding the quality of the overall research, as 48 percent of buy-side professionals believe that research quality is unchanged, whereas 44 percent of sell-side think that research quality has actually decreased[2]. When the survey regards the perception of overall research coverage, 45 percent of buy-side and 52 percent of sell-side professional perceive a decrease in research coverage since MiFID II introduction[3].

The concerns of survey's participants have actual reasons: as research fees are unbundled from trading fees, sell-side brokers may need to reorganize their research activity and focus their efforts on the most traded stocks, where the attention of buy-side firms is larger. Whether this reorganization of the sell-side brokers would result in a reduction in research production and ultimately whether this potential reduction would hamper stock market quality is an empirical issue that – in our opinion – is something worth studying.

[1] The uncertainty surrounding the effects of this regulatory provision is implicitly confirmed by the MiFID II regulation that itself requires that the Commission will present a report to the European Parliament and the Council on the impact of fee disclosure (see article 90 MiFID II).

[2] When small and mid-cap stocks are considered, the survey presents even more potentially critical results, as the percentage of buy-side professional believing that research quality is unchanged drops to 38 percent.

[3] For buy-side: only 2 percent believe the overall research coverage is increased, 29 percent believe is unchanged and 25 percent is not sure. For sell-side: 3 percent believe the overall research coverage is increased, 14 percent believe is unchanged and 31 percent is not sure.

A recent survey conducted by ICMA (2019) shows that 43 percent of the buy-side firms believe that after almost a year of MiFID II implementation the availability of research on small caps decreased. Also, a decrease in analyst coverage is also suggested by investor relations officers[4]. In particular Citigate Deve Rogerson believes that SMEs are the most affected by this issue. Small caps analyst coverage also concerns regulators in the United States, as the US House of Representatives passed a Bill on 9 July 2019 requiring the Securities and Exchange Commission (SEC) to study the provision of investment research for small issuers and emerging growth companies.

This paper intends to address two questions. First, we aim at providing quantitative evidence on the production of analyst reports following the introduction of MiFID II. Second, we intend to examine the impact of the research fee unbundling provision on secondary market quality, and particularly on stock liquidity and price efficiency.

We believe that the second question that we address is especially relevant as it is not clear whether the quantity of research that was available prior to MiFID II was in excess of the optimal one, as the costs were borne by investors (and not by users) and whether the quality of research was not related to the size of the firm and its trading commissions flow (see Harford et al. (2018)).

Our main findings suggest that MiFID II introduction produces a decrease in analyst coverage as well as a worsening in stock market liquidity. Both small and large cap stocks suffer a reduction in analyst coverage whereas liquidity drops only for small cap stocks, as the bid-ask spread for large caps is unaffected from the introduction of the directive. We also find mild but steady signals of an overall worsening in price efficiency. As robustness check we implement a difference-in-difference analysis which strongly supports our findings on analyst coverage and confirms the results for stock liquidity and price efficiency. Whereas previous papers already established a strong link between MiFID II and analyst coverage reduction, our marginal contribution refers to the effects on market liquidity and price efficiency. To the best of our knowledge, our paper is the first to address this topic.

The remainder of this paper is organized as follows: Section 2 presents the previous literature on the subject, Section 3 describes research design and testable hypotheses, Section

[4] Citigate Dewe Rogerson's 11th Annual Investor Relations survey, which is based on enquires to 242 European investor relations officers in 2019, shows 52 percent of UK companies report a decline in the number of analysts covering them and 38 percent report a fall in the quality of research from sell-side analysts.

4 describes the collected data set, Section 5 presents the results for our baseline regression as well as the difference-in-difference analysis and Section 6 concludes.

2. Previous literature

Roulston (2003) studies the relationship between analyst coverage and firms' stock market liquidity. The paper is based on a data set of 3,960 firm-month observations from 452 firms and the estimation model implements a 2SLS regression analysis with firm size, trading volume, stock price, return volatility, investor size, trading volume volatility and shares outstanding as control variables. Roulston (2003) finds a positive association between coverage and liquidity. This result is consistent with analyst coverage providing public information to the market and producing a reduction in the adverse-selection components of the bid-ask spread. The paper also studies the relationship between analyst forecast dispersion and market liquidity and finds that a low forecast dispersion in analyst estimates is associated with higher market liquidity, as measured by bid-ask spread and depth.

Fang et al. (2019) examine the effects of MiFID II on all public firms headquartered in European Economic Area (EEA) countries from February 2015 to February 2019. They find a significant decrease in sell-side analysts covering European firms since the implementation of MiFID II, with 334 firms losing their analyst coverage completely. The analysts who dropped coverage had higher lifetime forecast errors, higher forecast optimism, less experience on the job and less experience covering the firm that dropped. More positively, this paper finds that the stock recommendations issued by the remaining sell-side analysts are more profitable and gain greater market reactions, and sell-side analysts cater more to the buy-side by providing industry recommendations along their stock recommendations. Buy-side investment firms also used more in-house research after MiFID II with analysts increasing their participation and engagement in earnings conference calls. This paper also provides evidence that firms increased their disclosure activities following MiFID II and that stock-market liquidity decreased, after taking into account firms' disclosure responses and changes in analyst coverage.

Guo et al. (2019) study the effect of unbundling research from transaction with buy-side investors on a sample of 4,392 firms from 2014 to 2018. The authors find a reduction in research analyst coverage after MiFID II implementation in terms of number of analysts providing earning per share (EPS) estimates, as well as an increase in research quality measured as a decrease in forecast error in EPS estimates by analyst.[5] The paper also shows that the reduction in coverage affects, in particular, large firms and suggests the enhancement of analyst competition driven by research unbundling produces a drop out for inaccurate analysts and analyst who stay produce better-quality research, in opposition to Hong and Kacperczyk (2010) and Merkley et al. (2017), that propose a general reduction in coverage quality following a decrease in coverage quantity, as analyst feels a decrease in peers pressure.

Lang et al. (2019) also find a reduction in analyst following European firms with a decrease in coverage greatest for largest, oldest and less volatile firms. They also discover an increase in research quality for the remaining analyst but highlight a greater price reaction to earnings announcement as less aggregate information is conveyed by analyst forecast, suggesting an increase in the average bid-ask spread.

On the relevance of bundling research costs into overall transaction commission previous literature assumes diverging opinions, Johnsen (2009) defenses the irrelevance of these costs for investors income statement as well as an effective arrangement for the firm, others suggest that research bundling creates opacity and harms investors. Edelen at al. (2012) gathered mutual funds expenses and brokerage commission data from SEC and analyze the differential return impact of bundled payments versus expensed payments and find strong evidence that transparency helps to mitigate agency costs and that return impact of the payment is more negative when costs are bundled with commissions. Erzurumlu and Kotomin (2016) analyze a sample of actively managed US mutual funds and find that when research costs are bundled with brokerage commission the firm experience higher advisory fees but not higher risk-adjusted fund returns, suggesting that mutual funds do not benefit from the research supplied by brokers.

3. Research design

3.1. Hypotheses development

The goal of the paper is double. First, we aim at providing evidence on analyst coverage around the introduction of MiFID II. Second, we wish to examine the impact of the research fee unbundling provision on secondary market quality, particularly on stock liquidity and price efficiency.

[5] Measured as the difference between firm's actual EPS and the mean of analyst forecast.

In order to study our first proposition, we rely, as proxy for analyst coverage, on the number of EPS estimates made by analysts for a company per month as published by I/B/E/S. Being the most recurring estimate provided for listed stocks, this item can be intended as a substitute for the actual analyst coverage. According to our expectation we believe the introduction of MiFID II implies an overall reduction in analyst coverage and, in particular, a more severe reduction in analyst coverage for small cap firms. Our first testable hypothesis can be stated as follows.

Hypothesis 1 (H1): After the implementation of MiFID II analyst coverage, measured as the number of earning-per-shares estimates produced by analysts, suffers from a general reduction and (H1.1) small cap enterprises are most affected from this deterioration.

Our second proposition concerns the extent to which market liquidity and price efficiency are affected by MiFID II newly introduced provision on research fee unbundling. For this hypothesis we study stock bid-ask spreads at monthly frequency as well as price efficiency, through the estimation of an auto-regressive model on daily stock's return. We expect a worsening of stock's market liquidity, via an increase in bid-ask spread, and a worsening of stock's market efficiency, via an increase in the magnitude of the auto-regressive patterns in stocks' return. As stated above for H.1, we also believe that small cap firms experience a larger worsening of stocks market quality than mid and large caps. Our second testable hypothesis is organized in two sentences: hypothesis 2A tests for market liquidity and hypothesis 2B tests for price efficiency.

Hypothesis 2A (H2A): After the implementation of MiFID II, stock liquidity, measured as percentage bid-ask spread, worsens and (H2A.1) small cap stocks are the ones most affected from this drain in liquidity.

Hypothesis 2B (H2B): Due to what is postulated in H1 and H2, after the implementation of MiFID II the market experienced an overall reduction in price efficiency and (H2B.1) small cap enterprises are the ones most affected from this reduction in efficiency.

3.2. Econometric specification

Our baseline analysis consists in a regression analysis where we verify whether analyst coverage, market liquidity and price efficiency worsen after the introduction of MiFID II.

For H1 we present the following model:

$$analyst_{i,t} = \alpha_{0,i} + \alpha_1 mifid_{i,t} + \alpha_2 mktcap_{i,t} + \alpha_3 turn_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $analyst_{i,t}$, represents the number of EPS estimates published by analysts for stock i in month t, $mifid_{i,t}$ is a dummy variable which takes value of 1 for any month after January 2018, $mktcap_{i,t}$ represents the natural logarithm of market capitalization and $turn_{i,t}$ represents the traded volume for stock i in month t as percent of market capitalization (i.e., turnover or turnover velocity). We refrained from any log-transformation for $analyst_{i,t}$ in order to preserve its non-normal distribution.

For H2A the model is the following:

$$spread_{i,t} = \alpha_{0,i} + \alpha_1 mifid_{i,t} + \alpha_2 mktcap_{i,t} + \alpha_3 turn_{i,t} + \alpha_4 vola_{i,t} + \alpha_5 index_{i,t} + \varepsilon_{i,t} \quad (2)$$

where $spread_{i,t}$ is the average monthly bid-ask spread for stock i in month t, $turn_{i,t}$ represents the monthly-traded volume as percent of market capitalization, $vola_{i,t}$ expresses the twelve-month historical volatility of stock i and $index_{i,t}$ is the monthly return of the stock's index for stock i.

In order to verify H2B, concerning the efficiency of the market after the introduction of MiFID II, we rely on a simple model following Fama (1991) and we test whether the predictability of stock's returns increases after January 2018. For this analysis we employ a daily data set. The following equation presents the model for testing H2B:

$$\begin{aligned} ret_{i,t} = \alpha_{0,i} + \alpha_1 mifid_{i,t} + \alpha_2 ret_{i,t-1} + \alpha_3 (mifid_{i,t} * ret_{i,t-1}) + \alpha_4 mktcap_{i,t} \\ + \alpha_5 turn_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (3)$$

where $ret_{i,t}$ is the daily log-return for stock i and date t, $mifid_{i,t}$, $mktcap_{i,t}$, $turn_{i,t}$ represent the dummy variable for the introduction of MiFID II, the daily market capitalization and traded volume as proposed in equation (1). The coefficient α_3 captures any change in price efficiency after the introduction of the new Directive and we expect a coefficient statistically significant and different from zero. On the other hand, a coefficient equal to 0 or statistically not significant would express no alteration in price efficiency once MiFID II becomes effective. In order to cope with heteroskedasticity and serial correlation issues, we clustered standard errors at firms' level and we implemented firms fixed effect and time-month fixed effect as suggested by Petersen (2009).

As robustness check, we perform a difference-in-difference (DD) analysis for the models described by equations (1), (2) and (3). The goal of the DD is to check whether the findings observed in our baseline models can be generalized or they are specific for European firms. For this purpose, we compare the European sample with a non-European sample whose stocks do not fall under MiFID II application perimeter. For our DD analysis equation (1) is restated as following:

$$analyst_{i,t} = \alpha_0 + \alpha_1 mifid_{i,t} + \alpha_2 eu_{i,t} + \alpha_3(mifid_{i,t} * eu_{i,t}) + \alpha_4 mktcap_{i,t} + \alpha_5 turn_{i,t} + \varepsilon_{i,t} \tag{1b}$$

where $eu_{i,t}$ is a dummy variable which assumes value 1 for any European stocks and 0 otherwise and α_3 captures the interaction term equal to 1 for European stocks after MiFID II introduction. Equations (2) and (3) are restated as following:

$$spread_{i,t} = \alpha_0 + \alpha_1 mifid_{i,t} + \alpha_2 eu_{i,t} + \alpha_3\left(mifid_{i,t} * eu_{i,t}\right) + \alpha_4 mktcap_{i,t} + \alpha_5 turn_{i,t} + \alpha_6 vola_{i,t} + \alpha_7 index_{i,t} + \varepsilon_{i,t} \tag{2b}$$

$$ret_{i,t} = \alpha_0 + \alpha_1 mifid_{i,t} + \alpha_2 eu_{i,t} + \alpha_3 ret_{i,t-1} + \alpha_4\left(mifid_{i,t} * ret_{i,t-1}\right) + \alpha_5(mifid_{i,t} * eu_{i,t} * ret_{i,t-1}) + \alpha_6 mktcap_{i,t} + \alpha_7 turn_{i,t} + \varepsilon_{i,t} \tag{3b}$$

where α_4 captures the interaction term for $ret_{i,t-1}$ for European stocks after MiFID II introduction.

4. Data description

For our baseline regression analysis on H1 and H2A we collect monthly data for 2,117 stocks traded from eight major European stock markets[6] via Bloomberg Terminal for three years across MiFID II introduction, from 2016 to the end of 2018.

Stocks are randomly selected among those active during the sample period, with at least one earning-per-share analyst recommendation and after filtering for errors in the bid-ask spread variable. The resulting sample represents at least fifty percent of all listed securities in each country and of the overall country's market capitalization. The sample represents up to sixty percent of all the stock traded in the eight markets. For each stock we collect end-of-the-month trade price, bid and ask quote and traded volume within the month. The resulting data set is made of more than 76,000 firm-month observations.

To build a proxy for analyst coverage we follow Lee and So (2017) and collect the monthly number of earnings-per-share estimates provided by analysts and available on I/B/E/S. This variable, to the best of our knowledge, is the most accurate measure to proxy for analysts coverage as it captures the updated number of analysts covering a firm and reflects the number of estimates concurring in the calculation of the highly popular I/B/E/S Earnings per Share Total Number of Estimates in the Mean for the current fiscal year (EPS1NE)[7]. As control variables we gather stock's market capitalization, traded volume, twelve-month historical volatility and stock's index monthly returns.

Figure 1, Figure 3 and

Figure ***5*** represent, respectively, the average analysts' coverage, bid-ask spread and volatility for the entire sample period. As shown by Figure 1, the average number of analysts is above 7 before the introduction of MiFID II and drops by 0.3 after January 2018, describing a general reduction of analysts' activities. When liquidity is considered, January 2018 drives a sharp rise in the bid-ask spread which increases from 33 bps to 55 bps. Finally, Figure 5

[6] Austria, Belgium, Finland, France, Germany, Netherlands, Italy and United Kingdom.

[7] The EPS1NE varies monthly. Estimates are updated by contributing analyst sending a confirmation of their estimates, even though the estimated earnings-per-share does not change. When an analyst has not updated the estimate in the last 105 days, such estimate is filtered and excluded from the overall number of estimates. Although the cut-off deadline is set to 105 days, we observe that few estimates are older than one month and almost none is older than two months.

shows that volatility increases of approximately 2 percentage points after the introduction of MiFID II.

Table 1 presents the descriptive statistics of the sample. The market cap of the sample displays a mean of 3.68 billion of euro and a quite high standard deviation of 12.70 billion of euro, a 25th percentile set on 64 million of euro and a 75th percentile at 1.90 billion of euro. The observations for market capitalization are quite heterogenous in their dimension with a coefficient of variation equal to 3.45. The market capitalization is employed in the regression analysis with its natural logarithm (with a corresponding coefficient of variation of 0.22). The average number of analysts that publish an estimate on earning-per-share is over 7, with a standard deviation of 8 analysts, the 25th percentile has one analyst per stock and only from the 75th percentile upward the stock has more than 10 analysts. The average traded volume per month is 8.80 percent of the market capitalization, however half of the sample exchanges less than 0.4 percent in a month and only the highest 25th percentile that exchanges more than 12.57 percent of market capitalization. When we focus on risk, the average twelve-month historical volatility of the sample is 36.14 percent, with the 25th and the 75th percentile, respectively, equal to 23.80 and 42.10 percent.

Table 2 presents the descriptive statistics for analyst coverage and bid-ask spread partitioned by quartiles of market capitalization. As expected, liquidity is increasing in market capitalization and the average bid-ask spread decreases as the size of the firm increases, from a value of 121.33 bps for the 25th percentile to less than 1bps as market capitalization increases. For analyst coverage we observe the opposite behavior, as market capitalization increases the coverage increases as well, the 25th percentile has little more than one analyst following the firm, and half of the sample has less than three analysts, whereas when market capitalization is more than 1.9 billions of euro the average number of analysts following the stock increases to more than 6.45.

Table 3 presents a univariate analysis on analyst coverage and spread before and after the introduction of MiFID II. The monthly average number of analysts producing estimates was 7.06 before January 2018, after the implementation of MiFID II decreases by 0.14 to a value of 6.92, suggesting a statistically significant reduction of analysts' coverage for the entire sample. Whereas the average spread before January 2018 was 36.37 bps, after the introduction of the Directive increases by 3.72 bps to a value of 40.10 bps, suggesting a statistically significant drain of liquidity for the entire sample.

In order to understand whether less capitalized firms suffer more from MiFID II implementation, we organize the dataset in five different quintiles by market capitalization, Figure 8 and Figure 9 present, respectively, the average quintile analyst coverage and the average quintile spread for the first two quintiles (small-mid capitalized firms), the third quintile (mid capitalized firms) and the last two quintiles (mid-large firms). The two Figures also compare the European sample with the International sample we use in DD analysis.

For our baseline regression analysis on H2B, testing market efficiency, we collect for more than 1,750,000 daily observation from 2,117 different stocks. Table 4 analyses the descriptive statistics for daily returns on the entire dataset and for two different sub-periods, before and after MiFID II implementation. A comparison between the four moments of daily return distribution and auto-correlation coefficient for the two sub-sample periods allows us to acknowledge whether the Hypothesis of a reduction in market efficiency is a suitable one. When we study the first four moments of the return distribution, we observe mixed results: we have a change in sign of the average daily return, a mild increase in standard deviation and a more substantial decrease in asymmetry and leptokurtosis. However, when the auto-correlation coefficient is considered, we notice a sharp increase in an already significant negative auto-correlation: before MiFID II introduction the coefficient settles for -0.0189 whereas after the implementation drops by more than double to -0.0476. Figure 6 furtherly breaks down auto-correlation coefficient estimation in three-months sub-samples and shows that during the first three months after MiFID II introduction the auto-correlation coefficient reaches the record low of -0.0654 (-0.1600 for the first quintile) for European firm[8].

Table 8 presents the same univariate analysis proposed in Table 3 focusing the analysis only on the first two quintiles and the last two quintiles of the distribution for market capitalization. As expected, small-mid cap stocks suffer from a statistically significant reduction in liquidity after the introduction of the Directive. Additionally, for analyst coverage we find a significant reduction for both small-mid firms and mid-large firms. The average (median) bid-ask spread

[8] As additional efficiency test we also perform the Lo-MacKinlay (1988) Variance Ratio (VR) test on daily, weekly and two-weeks log-returns, which is described as follows: $VR(k) = \frac{\sigma^2(k)}{k*\sigma^2(1)}$, where $\sigma^2(k)$ is the variance for k-days sampling frequency. Our findings for the VR test support the hypothesis of worsening of price efficiency after MiFID II introduction as the test results imply a more efficient market before MiFID II introduction with one-week test (two-weeks) equal to 0.946 (0.924) whereas after MiFID II introduction the test result is equal to 0.907 (0.883). We also perform the test on a six-months timeframe and we observe that the test for the period from January 2018 to the end of June 2018 results in the lowest VR coefficient, equal to 0.897 (0.870).

for small-mid firms increases by 11.09 bps (2.92 bps) and the analyst coverage reduces by 0.09, a small number in absolute term but relatively speaking the analyst coverage reduced by almost 6 percent after January 2018. On the other hand, results for the mid-large firms are mixed, the analysis suggests a non-statistically significant decrease in liquidity and a decrease in analyst coverage after January 2018. The average (median) spread increases by 0.30 bps (0.01 bps) and the average number of analysts decreases by 0.30.

5. Results

5.1. Analyst coverage

Table 5 presents the results for equation (1) and verifies whether the number of estimates after the implementation of MiFID II drops. In S.1 we estimate the model in equation (1) using GLS, without control variables. The analysis suggests that after the introduction of MiFID II, the analyst coverage decreases by 0.14 analysts. When the analysis is performed with control variables, firm fixed effects and id's clustered standard errors (S.2) the average analyst coverage decreases by 0.17 analyst. Specification 3 provides a complete representation of the model described in equation (1), here we implement firm-time fixed effects. The result is an absolute increase in the magnitude of α_1, from January 2018 we have a general decrease of 0.18 estimates. As expected, market capitalization and traded volume are associated with an increase in analyst coverage of the stock.

As supplementary hypothesis we investigate the link between analyst coverage for small cap firms and the introduction of MiFID II. We assume that after January 2018 small cap firms suffer a relative larger loss in analyst coverage than large cap (H1.1), as sell-side analysts shift their attention away from smaller business. In order to answer to H1.1 we perform a quintile regression analysis as presented in Table 9. The analysis follows Eq.1 and applies S.3 to three different sub-samples. Firstly we create quintiles by market capitalization then, given the homogeneity of results and in order to ease the presentation, we organize the five quintiles in three different sub-samples: a first one representative of small-mid capitalized firms (S.Q1 – collecting the first and the second quintiles) a second one representative of the median firms in the sample (S.Q2 – collecting only the third quintile) and a last one representative of mid large capitalized firms (S.Q3 – collecting the fourth and the fifth quintiles). The first specification (S.Q1) studies the two smallest quintiles and suggests that firms with a mean market capitalization of 58 million euro suffer from a reduction of 0.21 analysts/estimates for the implementation of MiFID II. For this sub-sample the average number of active analysts before January 2018 is 1.56, a coefficient of -0.21 implies a reduction of 13 percent. S.Q2 analyzes firm with a mean market capitalization of 363 million euro and describes no statistical evidence on MiFID II. S.Q3 studies the two largest quintiles and suggests that firms with a mean market capitalization of 8,980 million of euros suffer from a reduction of 0.46 analysts for the implementation of MiFID II. For this sub-sample the average number of estimates before January 2018 is 14.16, a coefficient of -0.42 implies a reduction of circa 3 percent. Therefore, H1.1 is partially rejected: small cap firms do not suffer from a larger reduction in analyst coverage than large cap firms in absolute terms but only in percentage[9].

5.2. Market liquidity

Table 6 presents the results for H2 for the entire dataset. In Specification 4 (S.4) we perform the model in Eq. 2 using a GLS, without control variables. The analysis suggests that after the implementation of MiFID II, the bid-ask spread increases by 3.72 bps and the result increases to 6 bps when the analysis is performed with control variables, firm fixed effects and id's clustered standard errors (S.5). Specification 6 provides a complete representation of the model described in Eq. 2, here we implement firm-time fixed effects. The result is a decrease of 5.7 bps from January 2018 in the bid-ask spread. As expected, market capitalization and traded volume are associated with an increase in the liquidity of the stock, wider return of the stock index and a higher volatility, to a lesser extent, drive a decrease in the liquidity of the stock.

As already introduced for analyst coverage, we investigate the link between market liquidity for small capitalized firms and the introduction of MiFID II. Table 10 presents the quintile analysis for market liquidity following the same approach presented in Table 9 for analyst coverage. The first two quintiles seem the only ones where the introduction of MiFID II is linked to a general increase in bid-ask spread by 9.10 bps[10], for the other two specifications, S.Q5 and S.Q6, we find no relationship.

The analysis for market liquidity suggests that there is a probable relationship between the introduction of MiFID II and the increase in bid-ask spread, especially for smaller

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[9] If we perform a comparison between 1st and 5th quintile results are even more emphasized. For the 1st quintile the coefficient for $mifid_{i,t}$ is -0.283 and for the 5th quintile is -0.482.

[10] The link is stronger if we consider only the first quintile of market capitalization (with average market capitalization of 18 million euro) where the coefficient for $mifid_{i,t}$ is 0.166 (or 16.65 bps).

capitalized firms. The main control variable implemented in the analysis together with firm-time fixed effects helps us in identifying this relationship in, at least, an increase of 5.7 bps of bid-ask spread.

5.3. Price efficiency

In order to verify market efficiency after MiFID II introduction and test H2B, we rely on a daily dataset with the same stocks and same time span we consider for H1 and H2A. In this analysis the dataset is made of more than 1.7 million of daily observations. Table 7 present the results for the model presented in Eq. 3, Specification 7 represents the complete model for testing the significance of previous day log-return in shaping present returns. Via the interaction term in S.7 is it possible to assess whether the influence of $ret_{i,t-1}$ increases in magnitude after January 2018 and α_3, the coefficient for the interaction term $mifid_{i,t} * ret_{i,t-1}$ is negative and moderately statistically significant (5%) suggesting a possible increase in negative correlation after January 2018[11]. When we build two specific sub-samples, one pre and one post MiFID II implementation we observe a worsening of price efficiency after January 2018, as the coefficient of $ret_{t-1,i}$ decreases from -0.021 to -0.046. We then perform a quintiles analysis as proposed for analyst coverage and market liquidity also for price efficiency. The analysis does not report strong evidence regarding the decrease in price efficiency for the three selected sub-samples and the only single quintile with statistically significant coefficient at 5% for the interaction term $mifid_{i,t} * ret_{i,t-1}$ is the fifth one[12]. As per H2A (market liquidity), from our analysis we can only partially accept our initial hypothesis on price efficiency. Following the autocorrelation pattern presented in Figure 6, our findings suggest a probable decrease in price efficiency after MiFID II implementation and these findings are mildly confirmed only for larger capitalized firms (last three quintiles) when we perform the quintiles in spite of what expected by H2B.1.

[11] We expand our analysis by including additional lags in our model for S.7. and this expanded specification does not affect the statistical significance of $mifid_{i,t} * ret_{i,t-1}$.

[12] When we perform the analysis on the largest quintiles with an average market capitalization of 15,439 million euro, the coefficient for the interaction term is -0.151 with a t-statistic of -2.05.

5.4. Difference-in-Difference

As robustness check analysis we expand our data set by including international stocks from US and Japan as control sample that do not belong to MiFID II application area[13]. This allows to realize a DD analysis and control for potential confounding effects affecting both European and International stock market. For H1 and H2A we conduct our analysis on two different expanded dataset: the first one is the just the original dataset we use for our baseline analysis where we append the additional international stocks dataset (unmatched dataset) and the second one is a filtered version of the first one according to Rosenbaum and Rubin (1983) Propensity-Score Matching (PSM) by market capitalization (PSM dataset). For H2B we rely only on the unmatched dataset. Table 12 describes the main statistics for market capitalization, analyst coverage and bid-ask spread for the unmatched and the PSM data set. We only rely partially on PSM because the filtering process strongly shifts the shape of the market cap. distribution for the European sub-sample to the right-hand side, excluding some of the smallest capitalized firms. As presented in Table 13 DD analysis on analyst coverage confirms our findings of a reduction in the research activity on European firms by sell-side analyst after the introduction of the unbundling. When the analysis relies on the Unmatched-sample (S.D1 – S.D3) results confirm our previously presented findings as the size of the coefficient almost perfectly overlaps with S.3, as the analyst coverage reduces by 0.160. When the analysis relies on the PSM-sample the magnitude of the reduction increases up to -0.566 presenting some similarities with our quintiles analysis on mid-large capitalized firms (S.Q3). This increase in magnitude is fairly expected due to the effect produced by the matching mechanism on the average market capitalization for European firms which, as presented in Table 12, increases by almost two billion euros. Table 14 presents our findings for market liquidity using DD design. Results for the Unmatched-sample corroborates our findings from our baseline analysis, although with a smaller statistical significance, when we consider PSM-sample the analysis does not produce any statistical evidence[14]. Finally, Table 15 reports the results for

[13] We are currently broadening the data set employed in the Difference-in-Difference analysis by gathering data on additional stocks. The expansion mostly relates to non-European firms as the number of European firm remains mostly unchanged. The raw available number of non-European firms is 5,750.

[14] As already mentioned for Table 13 we believe that the matching mechanism produces a general upward shift in the market capitalization distribution for European firms resulting in a lesser significance of the interaction term $mifid_{i,t} * eu_{i,t}$ on the overall sample.

price efficiency on the Unmatched-sample which mostly overlap with findings from our baseline analysis.

6. Conclusions

The requirement to price sell-side analyst research separately from trading execution introduced by MiFID II produces a profound change in the business model of brokerage firms. On the one hand investors benefit from the additional transparency delivered by the Directive, on the other hand sell-side analysts need to adapt to this new provision by focusing their efforts on producing profitable research only. In this not clear on an ex ante basis what is the final effect on market quality.

This paper offers preliminary findings regarding the effects on stock market quality following the introduction of the MiFID II provision on unbundling research fees. Our empirical analysis confirms the findings from previous papers and shows a clear reduction in analyst coverage for small and large cap stocks. In addition to previous literature we discover a sharp increase in bid-ask spread for small cap stocks, suggesting a deterioration of liquidity after MiFID II implementation. Regarding price efficiency we observe a mild deterioration of this condition due to the increase in negative autocorrelation of daily returns.

References

Citigate Dewe Rogerson (2019). 11th Annual Investor Relators survey: UK companies among the hardest hit by decline in analyst coverage.

CFA Institute (2019). MiFID II: One Year On, Assessing the Market for Investment Research.

Edelen, R. M., Evans, R. B., & Kadlec, G. B. (2012). Disclosure and Agency Conflict: Evidence from Mutual Fund Commission Bundling. Journal of Financial Economics, 103(2), 308-326.

Erzurumlu, Y. Ö., & Kotomin, V. (2016). Mutual Funds' Soft Dollar Arrangements: Determinants, Impact on Shareholder Wealth, and Relation to Governance. Journal of Financial Services Research, 50(1), 95-119.

Fang, B., Hope, O. K., Huang, Z., & Moldovan, R. (2019). The Effects of MiFID II on Sell-Side Analysts, Buy-Side Analysts, and Firms. Buy-Side Analysts, and Firms. Available at SSRN: https://ssrn.com/abstract=3422155.

Guo, Y., & Mota, L. (2019). Should Information be Sold Separately? Evidence from MiFID II. Available at SSRN: https://ssrn.com/abstract=3399506.

Harford, J., Jiang, F.,Wang, R. & Xie, F. (2018). Analyst Career Concerns, Effort Allocation, and Firms' Information Environment, The Review of Financial Studies, 32(6), 2179-2224.

Hong, H. & Kacperczyk, M. (2010). Competition and Bias. The Quarterly Journal of Economics, 125(4), 1683-1725.

International Capital Market Association – ICMA (2019). MiFID II/R and the bond markets: the second year, an analysis of the impacts of MiFID II/R implementation in 2019, its challenges and potential solutions, December 2019.

Johnsen, D. B. (2009). Myths about Mutual Fund Fees: Economic insights on Jones v. Harris. The Journal of Corporate Law, 35, 561.

Lang, M. H., Pinto, J., & Sul, E. (2019). MiFID II Unbundling and Sell Side Analyst Research. Available at SSRN: https://ssrn.com/abstract=3408198.

Lee, C. M., & So, E. C. (2017). Uncovering Expected Returns: Information in Analyst Coverage Proxies. Journal of Financial Economics, 124(2), 331-348.

Lo, A. W. & MacKinlay A.C. (1988). Stock Market Prices Do Not Follow Random Walks: Evidence from a Simple Specification Test, The Review of Financial Study, 1, 41-66.

Merkley, K., Michaely, R. & Pacelli, J., (2017). Does the Scope of the Sell-Side Analyst Industry Matter? an Examination of Bias, Accuracy, and Information Content of Analyst Reports. The Journal of Finance, 72(3), 1285-1334.

Petersen, M. A., (2009). Estimating Standard Errors in Finance Panel Data Sets: comparing approaches, Review of Financial Studies, 22(1), 435–480.

Roulstone, D. T. (2003). Analyst Following and Market Liquidity. Contemporary Accounting Research, 20(3), 552-578.

Rosenbaum, P. R., & D. B. Rubin, (1983). The Central Role of the Propensity Score in Observational Studies for Causal Effects. Biometrika, 70(1), 41–55.

Tables and Figures

Figure 1 – Average analyst coverage for the sample

The sample is based on a dataset of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. The Figure represents the average monthly analyst coverage for the entire sample. Analyst coverage is the number of estimates on earning-per-share published by analysts for the stock for each month.

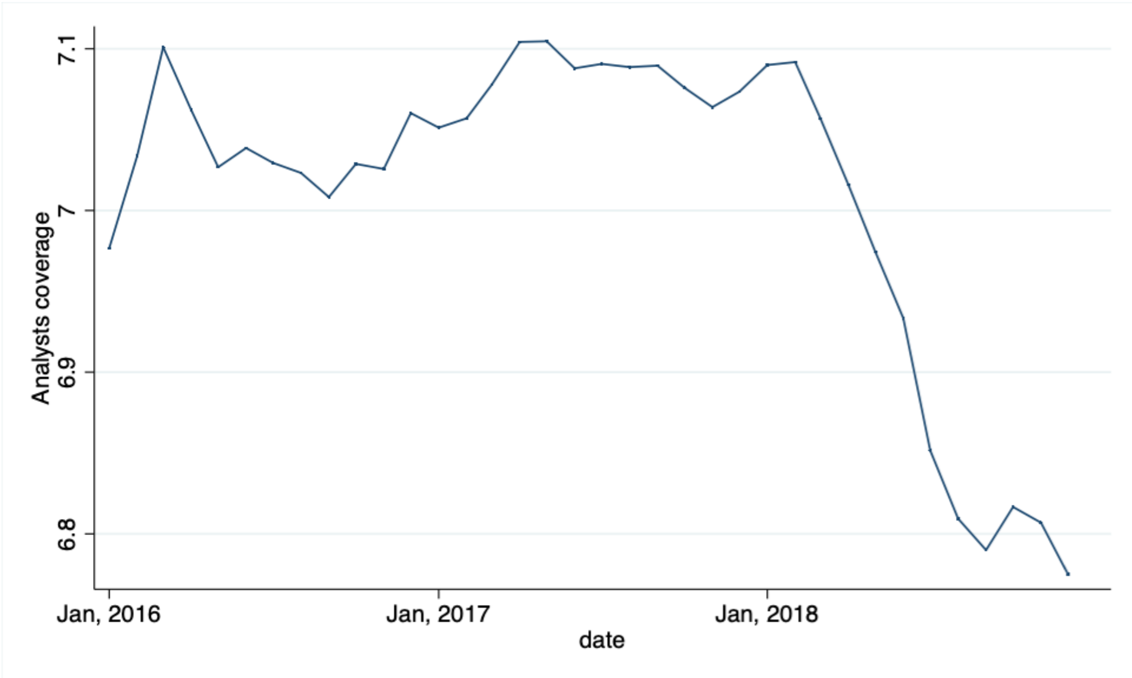

Figure 2 – Average analyst coverage for overall sample

The sample is based on a dataset of circa 100,000 monthly observation from 2,770 stock for eight major European countries, USA and Japan from 2016 to 2018. The Figure represents the average monthly analyst coverage for the entire sample. Analyst coverage is the number of estimates on earning-per-share published by analysts for the stock for each month.

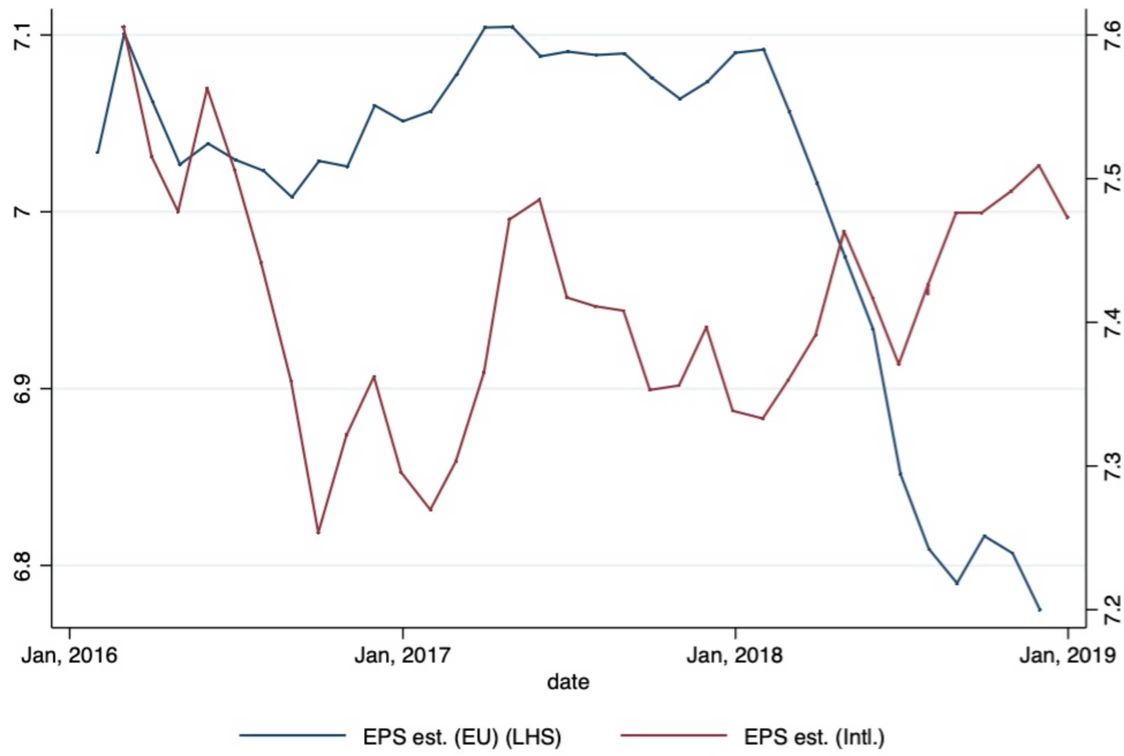

Figure 3 – Average bid-ask spread for the sample

The sample is based on a dataset of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. The Figure represents the average bid-ask spread in bps for the entire sample.

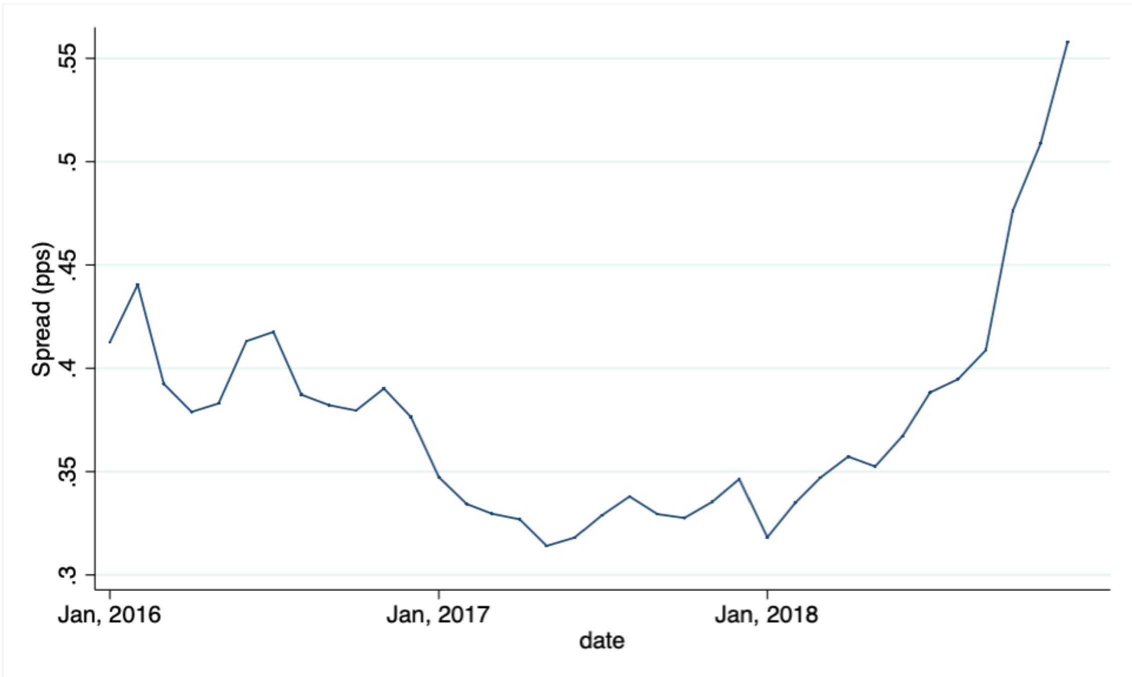

Figure 4 – Average bid-ask spread for the DD sample

The sample is based on a dataset of circa 100,000 monthly observation from 2,770 stock for eight major European countries, USA and Japan from 2016 to 2018. The Figure represents the average bid-ask spread in bps for the entire sample.

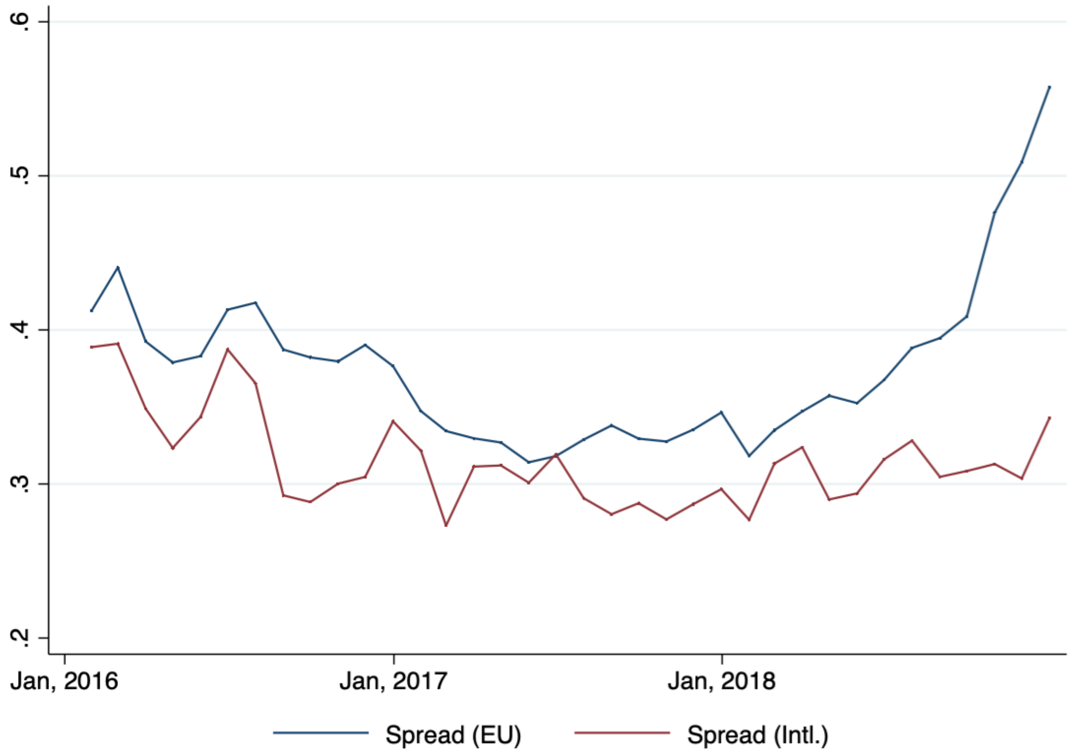

Figure 5 – Average volatility for the sample

The sample is based on a dataset of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. The Figure represents the average historical volatility for the entire sample.

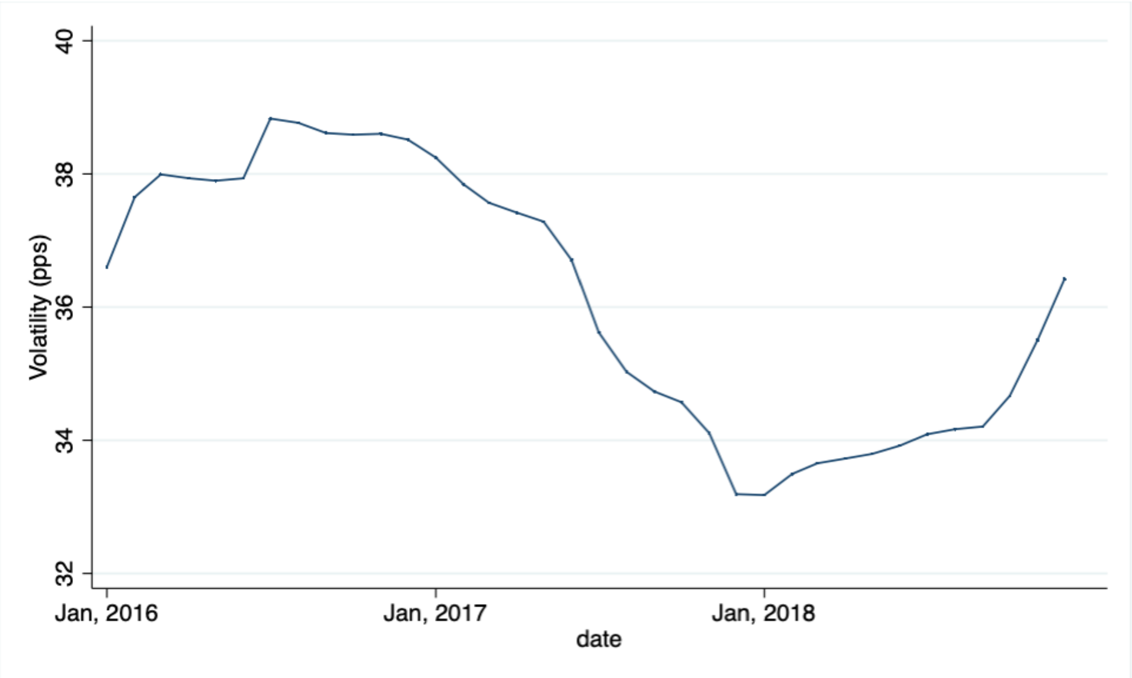

Figure 6 – Three-months daily autocorrelation in the sample

The sample is based on a dataset of circa 1,978,000 daily observation from 2,550 stocks for eight major European countries, USA and Japan from 2016 to 2018. Figure 6 describes the last three-months autocorrelation in daily log-returns for the European and International samples. Values are expressed in percentage points, solid dot values represent 1% statistically significant coefficients and empty dot values represent non-statistically significant coefficients.

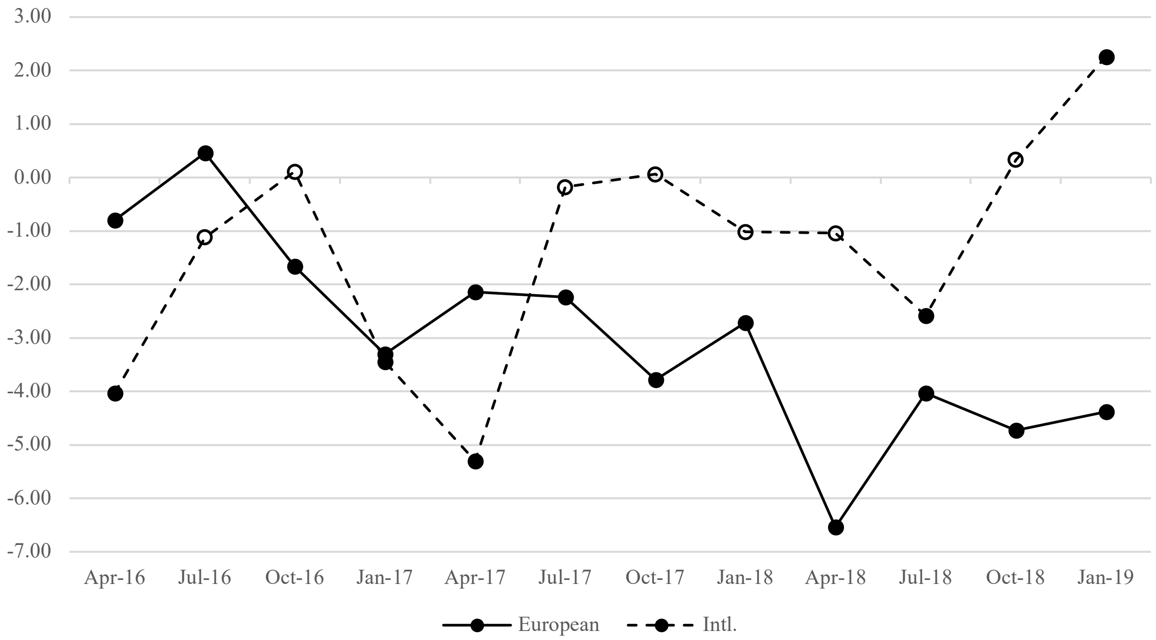

Figure 7 – Three-months daily autocorrelation in the first quintile by market capitalization

The sample is based on a dataset of circa 337,000 daily observation from an original dataset of 2,550 stocks for eight major European countries, USA and Japan from 2016 to 2018. The Figure describes the last three-months autocorrelation in daily log-returns for the first quintile by market capitalization for European and International sub-samples. Values are expressed in percentage points, solid dot values represent 1% statistically significant coefficients and empty dot values represent non-statistically significant coefficients.

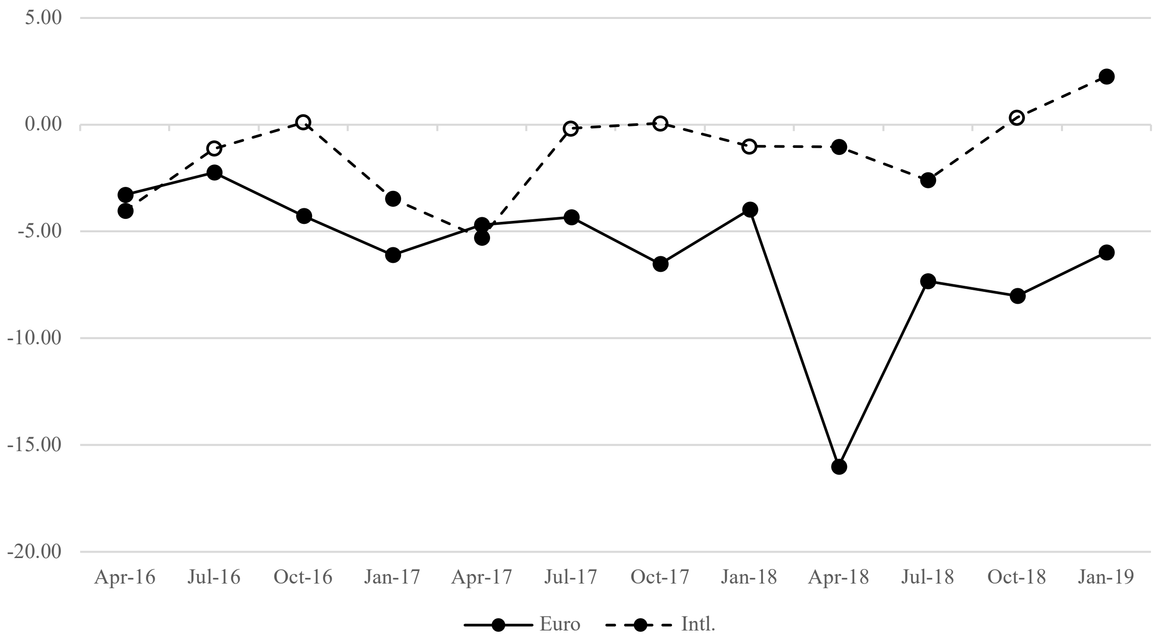

Figure 8 – Average analyst coverage for the overall sample by market cap. quintiles

The Figure describes average analyst coverage by market capitalization quintiles. The sample is based on a dataset of circa 100,000 monthly observation from 2,770 stock for eight major European countries, USA and Japan from 2016 to 2018. The Figure represents the average monthly analyst coverage for the entire sample. Analyst coverage is the number of estimates on earning-per-share published by analysts for the stock for each month.

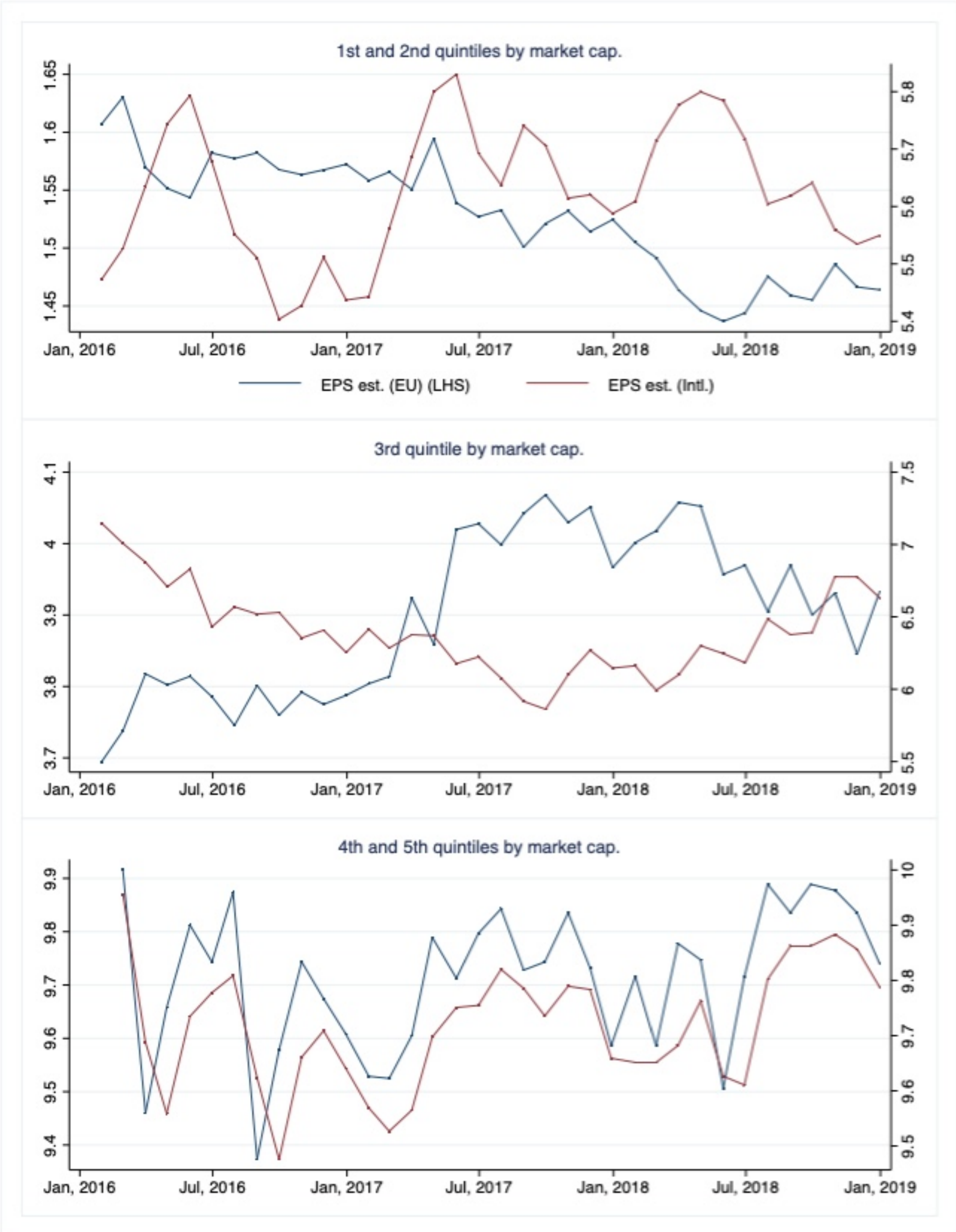

Figure 9 – Bid-Ask Spread for the overall sample by market cap. Quintile

The Figure describes average bid-ask spread by market capitalization quintiles. The sample is based on a dataset of circa 100,000 monthly observation from 2,770 stock for eight major European countries, USA and Japan from 2016 to 2018. The Figure represents the average bid-ask spread in bps for the entire sample.

Table 1 – Descriptive Statistics

The sample is based on a data set of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. Spread represents the average bid-ask spread quoted during that month in bps, analyst coverage is the number of estimates on earning-per-share published by analysts for the stock for each month, volume is the traded volume and is expressed in percentage points of market capitalization (turnover velocity), volatility represents the twelve-month historical volatility and Index return is the monthly log-return for the market index of stock *i*.

Variable	Unit of measure	N. obs.	Mean	St. Dev.	p25	p50	p75
Market capitalization	Millions of euro	76,212	3,680	12,700	64	338	1,900
Analyst coverage	N. analysts	76,212	7.011	8.070	1	3	10
Spread (raw)	bps	76,212	37.62	110.7	0.23	1.76	13.22
Spread (excl. 95^{th} pct.)	bps	72,399	14.37	33.59	0.21	1.48	9.16
Volume (turnover)	pps of Market cap.	76,212	8.799	14.770	0.090	0.370	12.570
Volatility	pps	76,212	36.14	18.54	23.80	31.10	42.10
Index return	pps	76,212	0.072	3.440	-5.845	0.309	2.224

Table 2 – Market cap. percentile statistics for Analyst coverage and Spread

The sample is based on a dataset of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. Analyst coverage is the number of estimates on earning-per-share published by analysts for the stock for each month, Spread represent the average bid-ask spread quoted during that month in bps. The dataset is organized with 25th, 50th, 75th and 100th percentile of market capitalization.

Variable	Percentile	N.Obs.	Mean	St. Dev.
Analyst coverage	25th	19,080	1.16	0.96
	50th	19,044	2.61	2.19
	75th	19,044	6.45	4.52
	100th	19,044	17.83	7.95
Spread	25th	19,080	121.33	185.09
	50th	19,044	21.79	63.18
	75th	19,044	6.52	33.69
	100th	19,044	0.66	2.55

Table 3 – Univariate analysis for Analyst coverage and Spread before and after MiFID II

The sample is based on a dataset of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. Analyst coverage is the number of estimates on earning-per-share published by analysts for the stock for each month, Spread represent the average bid-ask spread quoted during that month in bps

Variable	Period	N.Obs.	Mean	St. Dev.	p25	p75	T-stat
Analyst coverage	Pre-MiFID II	50,808	7.06	8.13	1	10	195.78
	Post-MiFID II	25,404	6.92	7.95	1	10	138.65
	Delta		-0.14				-2.27
Spread	Pre-MiFID II	50,808	36.37	107.78	0.24	12.86	76.07
	Post-MiFID II	25,404	40.10	116.33	0.22	14.13	54.94
	Delta		3.72				4.27

Table 4 – Descriptive statistics for daily returns before and after MiFID II

The sample is based on a dataset of circa 1,750,000 daily return observation from 2,117 stock for eight major European countries from 2016 to 2018.

Period	N.Obs.	Mean	St. Dev.	p25	p75	Skewness	Kurtosis	Auto-correlation
Pre-MiFID II	989,386	0.0003	0.0358	-0.0075	0.0076	38.47	5,351	-0.0189 ***
Post-MiFID II	761,327	-0.0007	0.0375	-0.0088	0.0075	21.29	4,222	-0.0476 ***
Entire sample	1,751,618	-0.0001	0.0365	-0.0081	0.0075	30.44	4,822	-0.0319 ***

Table 5 – Model specifications for analyst coverage

The sample is based on a dataset of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. Analyst coverage is the number of analysts that publish an estimate on the earning-per-share of the stock for each month, Market cap. is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization. The Table presents the model introduced in Eq. 1 where the dependent variable is *Analyst coverage*, Specification 1 proposes the GLS model without control variables, Spec. 2 w.r.t. Spec. 1 introduces control variables, id's clustered standard errors and firm fixed effect, Spec. 3 introduces year-month time fixed effects. Coefficients in bold are statistically significant at 1% and standard errors are clustered according to Petersen (2009).

Variables	1		2		3	
	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat
Market cap.			**0.284**	4.27	**0.289**	4.23
Turnover			**0.074**	3.58	**0.071**	3.36
$mifid_{i,t}$	**-0.140**	-4.43	**-0.170**	-5.30	**-0.180**	-4.31
Std. Errors	Firm-clustered		Firm-clustered		Firm-clustered	
Firm fixed effects	No		Yes		Yes	
Time fixed effects	No		No		Year-Month	
Adj. R-squared	0.01%		30.43%		30.31%	
F-stat (robust)	19.65		18.36		11.51	
N. Observation	76,212		76,212		76,212	

Table 6 – Model specifications for liquidity effect

The sample is based on a dataset of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. Spread represent the average bid-ask spread quoted during that month in bps. Turnover is the traded volume expressed in percentage points of market capitalization, Volatility represents the twelve-month historical volatility and Index return is the monthly log-return for the market index of stock i. Table 6 resents the model introduced in Eq. 2 where the dependent variable is *spread*, Specification 4 proposes the GLS model without control variables, Spec. 5 w.r.t. Spec. 4 introduces control variables, id's clustered standard errors and firm fixed effect, Spec. 6 introduces year-month time fixed effects.. Coefficients in bold are statistically significant at 1% and standard errors are clustered according to Petersen (2009)..

Variables	4		5		6	
	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat
Market cap.			**-0.215**	-3.68	**-0.215**	-3.62
Turnover			**-0.057**	-7.33	**-0.055**	-7.09
Volatility			**0.004**	2.97	**0.004**	2.97
Index			**-0.005**	-12.18	**-0.005**	-11.43
$mifid_{i,t}$	**0.037**	3.24	**0.060**	4.62	**0.057**	3.17
Std. Errors	Firm-clustered		Firm-clustered		Firm-clustered	
Firm fixed effects	No		Yes		Yes	
Time fixed effects	No		No		Year-Month	
R-squared within	0.03%		8.87%		9.15%	
F-stat (robust)	10.52		40.71		17.54	
N. Observation	76,212		76,212		76,212	

Table 7 – Model specifications for price efficiency

The sample is based on a dataset of circa 1,626,000 daily observation from 2,117 stock for eight major European countries from 2016 to H1 2019.$ret_{i,t}$ represents the log-return for stock *i* in time *t*. Turnover is the traded volume expressed in percentage points of market capitalization. Table 7 presents the model introduced in Eq. 3 where the dependent variable is $ret_{i,t}$, Specification 7 proposes the model for the entire dataset, Whereas Spec. 8 and Spec. 9 apply Eq. 3, respectively, on the period Pre-MiFID II and Post-MiFID II. The model uses id's clustered standard errors, and firm-time fixed effect. Coefficients in bold are statistically significant at 1% and standard errors are clustered according to Petersen (2009).

Variables	7		8		9	
	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat
Market cap.	**0.005**	9.11	**0.006**	8.41	**0.012**	9.05
Turnover	0.099	1.20	**0.273**	2.64	-0.025	-0.24
$ret_{i,t-1}$	**-0.017**	-2.83	**-0.021**	-3.46	**-0.046**	-3.66
$mifid_{i,t}$	**-0.000**	-2.94				
$mifid_{i,t} * ret_{i,t-1}$	-0.024	-2.06				
Time Span	Entire sample		Pre-MiFID II		Post-MiFID II	
Std. Errors	Firm-clustered		Firm-clustered		Firm-clustered	
Firm fixed effects	Yes		Yes		Yes	
Time fixed effects	Year-Month		Year-Month		Year-Month	
Adj. R-squared	1.00%		1.00%		1.00%	
F-stat (robust)	85.60		60.42		93.06	
N. Observation	1,615,829		913,521		702,308	

Table 8 – Univariate analysis for quintiles of market capitalization

The sample is based on a dataset of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. Analyst coverage is the number of analysts that publish an estimate on the earning-per-share of the stock for each month Spread represent the average bid-ask spread quoted during that month in bps. Quintiles are organized by market capitalization in every month of the sample, the average market capitalization for the first two (last two) quintiles is 58 mln euro (8,980 mln euro).

Variable	Period	N.Obs.	Mean	St. Dev.	p25	p50	p75	T-stat
			First and second quintiles by market capitalization					
Analyst coverage	Pre-Mifid II	20,328	1.56	1.35	1	1	2	164.26
	Post-Mifid II	10,164	1.47	1.45	1	1	2	102.21
	Delta		-0.09			0.00		-5.31
Spread	Pre-Mifid II	20,328	83.58	155.61	3.62	16.44	69.29	76.58
	Post-Mifid II	9,317	94.67	168.19	4.36	19.36	79.73	54.33
	Delta		11.09			2.92		5.39
			Fourth and fifth quintiles by market capitalization					
Analyst coverage	Pre-Mifid II	20,304	14.16	8.53	7	13	21	236.46
	Post-Mifid II	9,306	13.82	8.33	7	13	20	160.06
	Delta		-0.34			0.00		-3.21
Spread	Pre-Mifid II	20,304	2.06	14.87	0.04	0.21	0.92	19.76
	Post-Mifid II	9,306	1.76	14.45	0.04	0.20	0.81	11.74
	Delta		-0.30			-0.01		-1.67

Table 9 – Quintiles analysis for analyst coverage

The sample is based on a dataset of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. Analyst coverage is the number of analysts that publish an estimate on the earning-per-share of the stock for each month. Market cap. is the natural logarithm of market capitalization expressed in millions of euro. Turnover is the traded volume expressed in percentage points of market capitalization. Table 9 presents the model introduced in Eq. 1 where the dependent variable is *analyst coverage*, and applies a S.3 model with quintile analysis on five different quintiles organized by market capitalization. Results are organized in three different sub-sample, the first two quintiles (small-mid cap.), the third quintile (mid cap.) and the last two quintiles (mid-large cap.). The model performs a firm-time fixed effects analysis. Coefficients in bold are statistically significant at 1% and standard errors are clustered according to Petersen (2009).

Variables	S.Q1 – (1st - 2nd)		S.Q2 (3rd)		S.Q3 (4th - 5th)	
	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat
Mean Mkt. cap.	58 mln		363 mln		8,980 mln	
Median Mkt. cap	44 mln		338 mln		2,690 mln	
Market cap.	**0.101**	3.59	**0.493**	3.88	**1.223**	5.69
Turnover	0.005	0.56	0.031	1.40	**0.462**	4.31
$mifid_{i,t}$	**-0.217**	-7.18	0.003	0.04	**-0.419**	-4.32
Std. error	Firm-clustered		Firm-clustered		Firm-clustered	
Firm FE	Yes		Yes		Yes	
Time FE	Year-Month		Year-Month		Year-Month	
R-squared within	4.02%		1.81%		5.06%	
F-stat (robust)	4.22		2.29		12.96	
N. Observation	30,492		15,264		30,456	

Table 10 – Quintiles analysis for liquidity effect

The sample is based on a dataset of circa 76,000 monthly observation from 2,117 stock for eight major European countries from 2016 to 2018. Spread represent the average bid-ask spread quoted during that month in bps. Market cap. is the natural logarithm of market capitalization expressed in millions of euro. Turnover is the traded volume expressed in percentage points of market capitalization, Volatility represents the twelve-month historical volatility and Index return is the monthly log-return for the market index of stock i. Table 10 presents the model introduced in Eq. 2 where the dependent variable is *spread*, and applies a S.6 model with quintiles analysis on five different quintiles organized by market capitalization. Results are organized in three different sub-sample, the first two quintiles (small-mid cap.), the third quintile (mid cap.) and the last two quintiles (mid-large cap.). The model performs a firm-time fixed effects analysis. Coefficients in bold are statistically significant at 1% and standard errors are clustered according to Petersen (2009).

Variables	S.Q4 – (1st - 2nd)		S.Q5 (3rd)		S.Q6 (4th - 5th)	
	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat
Mean Mkt. cap.	58 mln		363 mln		8,980 mln	
Median Mkt. cap	44 mln		338 mln		2,690 mln	
Market cap.	**-0.359**	-2.86	**-0.115**	-6.17	-0.066	-2.00
Turnover	**-0.077**	-6.72	**-0.020**	-2.79	-0.010	-1.36
Volatility	0.004	2.08	0.001	1.09	0.002	1.78
Index	**-0.012**	-10.04	**-0.003**	-4.22	-0.000	-1.70
$mifid_{i,t}$	**0.091**	2.65	-0.010	-1.10	0.021	1.48
Std. error	Firm-clustered		Firm-clustered		Firm-clustered	
Firm FE	Yes		Yes		Yes	
Time FE	Year-Month		Year-Month		Year-Month	
R-squared within	14.44%		4.62%		4.84%	
F-stat (robust)	18.18		3.90		2.93	
N. Observation	30,492		15,264		30,456	

Table 11 – Quintile analysis for price efficiency

The sample is based on a dataset of circa 1,626,000 daily observation from 2,117 stock for eight major European countries from 2016 to H1 2019.$ret_{i,t}$ represents the log-return for stock *i* in time *t*. Turnover is the traded volume expressed in percentage points of market capitalization. Table 11 presents the model introduced in Eq. 3 where the dependent variable is $ret_{i,t}$, and applies a S.7 model with quintiles analysis on five different quintiles organized by market capitalization. Results are organized in three different sub-sample, the first two quintiles (small-mid cap.), the third quintile (mid cap.) and the last two quintiles (mid-large cap.). The model performs a firm-time fixed effects analysis. Coefficients in bold are statistically significant at 1% and standard errors are clustered according to Petersen (2009).

Variables	S.Q7 – (1st - 2nd)		S.Q8 (3rd)		S.Q9 (4th - 5th)	
	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat
Market cap.	**0.005**	6.63	**0.005**	12.90	**0.004**	10.13
Turnover	0.157	1.53	-0.059	-0.82	**-0.115**	-3.02
$ret_{i,t-1}$	**-0.031**	-3.51	-0.016	-2.13	0.014	1.43
$mifid_{i,t}$	**-0.002**	-6.81	**-0.003**	-13.61	-0.000	-1.62
$mifid_{i,t} * ret_{i,t-1}$	-0.025	-1.41	-0.017	-1.83	-0.075	-1.75
Std. Errors	Firm-clustered		Firm-clustered		Firm-clustered	
Firm fixed effects	Yes		Yes		Yes	
Time fixed effects	Year-Month		Year-Month		Year-Month	
Adj. R-squared	0.54%		0.28%		0.45%	
F-stat (robust)	28.86		38.99		71.38	
N. Observation	606,933		337,456		608,635	

Table 12 – Descriptive statistics for unmatched dataset and PSM dataset

The Table describes the most relevant statistics for the two different dataset we use in our DD analysis. The Unmatched dataset relies on the original European dataset we use for our baseline analysis and comprehends The sample is based on a dataset of 99,716 monthly observation from 2,770 stock for eight major European countries, USA and Japan from 2016 to 2018. The PSM dataset applies Propensity Score Matching to our Unmatched dataset in order to compare European and International firms with homogenous moments statistics for the market capitalization variable, resulting in a less populated dataset.

Unmatched dataset	**N.Obs**	**Mean**	**St.Dev**	**p25**	**p50**	**p75**
			International sample			
Market capitalization	23,504	5,626	19,352	614	1,531	4,041
Analyst	23,504	7.42	6.11	3.00	6.00	10.00
Spread	23,504	31.52	93.58	7.45	16.60	30.40
			European sample			
Market capitalization	76,212	3,685	12,697	64	338	1,802
Analyst	76,212	7.01	8.07	1.00	3.00	10.00
Spread	76,212	37.62	110.72	0.23	1.76	13.22
			Total			
Market capitalization	99,716	4,142	14,565	103	564	2,447
Analyst	99,716	7	8	2	4	10
Spread	99,716	36.18	106.96	0.47	3.94	21.42
PSM dataset	**N.Obs**	**Mean**	**St.Dev**	**p25**	**p50**	**p75**
			International sample			
Market capitalization	35,253	5,516	18,756	592	1,498	3,994
Analyst	35,253	7.49	6.17	3.00	6.00	10.00
Spread	35,253	31.64	97.64	7.59	16.86	30.67
			European sample			
Market capitalization	40,277	5,583	17,698	169	632	3,031
Analyst	40,277	7.93	7.30	2.00	5.00	12.00
Spread	40,277	136.63	303.29	12.26	46.73	145.59
			Total			
Market capitalization	75,530	5,551	18,200	290	1,058	3,588
Analyst	75,530	8	7	3	5	11
Spread	75,530	87.63	237.15	9.35	24.39	68.55

Table 13 – Diff-in-Diff model specifications for analyst coverage

The sample is based on a dataset of 99,719 (50,347 for PSM Specification) monthly observation from 2,770 (1,400) stock for eight major European countries, USA and Japan from 2016 to 2018. Analyst coverage is the number of analysts that publish an estimate on the earning-per-share of the stock for each month, Market cap. is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization. The Table presents the model introduced in Eq. 1b where the dependent variable is *Analyst coverage*, S.D1 proposes the GLS model with control variables and Firm-clustered standard errors, S.D2 introduces Firm fixed effects, S.D3 introduces Year and Month fixed effects and S.D4 applies the same specification of S.D3 to a dataset adjusted using Propensity Score Matching (PSM). Coefficients in bold are statistically significant at 1% and standard errors are clustered according to Petersen (2009).

Variables	S.D1		S.D2		S.D3		S.D4 (PSM)	
	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat
Market cap.	**0.335**	5.04	**0.295**	4.59	**0.303**	4.55	**0.762**	10.22
Turnover	**0.080**	4.35	**0.079**	4.04	**0.075**	3.79	**0.224**	4.19
$mifid_{i,t}$	-0.016	-0.26	-0.010	-0.17	-0.030	-0.45	**-0.380**	-4.44
$eu_{i,t}$	0.651	1.99						
$mifid * eu_{i,t}$	**-0.159**	-2.32	**-0.160**	-2.33	**-0.160**	-2.34	**-0.566**	-5.74
Std. Errors	Firm-clustered		Firm-clustered		Firm-clustered		Firm-clustered	
Firm fixed effects	No		Yes		Yes		Yes	
Time fixed effects	No		No		Year-Month		Year-Month	
Adj. R-squared	27.17%		9.90%		9.77%		35.32%	
F-stat (robust)	72.24		15.21		11.42		20.46	
N. Observation	99,719		99,719		99,719		50,347	

Table 14 – Diff-in-Diff model specifications for liquidity effect

The sample is based on a dataset of 99,719 (50,347 for PSM Specification) monthly observation from 2,770 (1,400) stock for eight major European countries, USA and Japan from 2016 to 2018. Spread represent the average bid-ask spread quoted during that month in bps. Turnover is the traded volume expressed in percentage points of market capitalization, Volatility represents the twelve-month historical volatility and Index return is the monthly log-return for the market index of stock *i*. The Table presents the model introduced in Eq. 2b where the dependent variable is *spread*, S.D5 proposes the GLS model with control variables and Firm-clustered standard errors, S.D6 introduces Firm fixed effects and S.D7 introduces Year and Month fixed effects. S.D8 applies the same specification of S.D7 to a dataset adjusted using Propensity Score Matching (PSM). Coefficients in bold are statistically significant at 1% and standard errors are clustered according to Petersen (2009).

Variables	S.D5		S.D6		S.D7		S.D8 (PSM)	
	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat
Market cap.	**-0.171**	-5.43	**-0.224**	-3.99	**-0.222**	-3.89	**-0.654**	-9.03
Turnover	-0.001	-1.51	-0.000	-1.49	-0.001	-1.53	**0.003**	4.52
Volatility	0.000	1.47	0.000	1.34	0.000	1.32	-0.000	-1.07
Index	**-0.005**	-10.93	**-0.005**	-10.11	**-0.005**	-8.95	0.376	-0.36
$mifid_{i,t}$	0.012	0.85	0.020	1.27	0.012	0.59	**0.098**	**3.86**
$eu_{i,t}$	**-0.289**	-4.31						
$mifid * eu_{i,t}$	0.036	2.11	0.035	2.04	0.035	2.04	0.266	0.75
Std. Errors	Firm-clustered		Firm-clustered		Firm-clustered		Firm-clustered	
Firm fixed effects	No		Yes		Yes		Yes	
Time fixed effects	No		No		Year-Month		Year-Month	
Adj. R-squared	4.02%		3.97%		3.99%		20.82%	
F-stat (robust)	193.48		30.89		16.04		11.14	
N. Observation	99,719		99,719		99,719		50,347	

Table 15 – Diff-in-Diff model specifications for price efficiency

The sample is based on a dataset of circa 2,193,000 daily observation from 2,544 stock for eight major European countries, U.SA. and Japan from 2016 to H1 2019.$ret_{i,t}$ represents the log-return for stock i in time t. Turnover is the traded volume expressed in percentage points of market capitalization. The Table presents the model introduced in Eq. 3b where the dependent variable is $ret_{i,t}$, S.D9 proposes a GLS with control variables and Firm-clustered standard errors, S.D10 introduces Firm fixed effects and S.D11 introduces Year and Month fixed effects. Coefficients in bold are statistically significant at 1% and standard errors are clustered according to Petersen (2009).

Variables	S.D9		S.D10		S.D11	
	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat
Market cap.	**0.000**	5.52	**0.004**	10.79	**0.005**	10.70
Turnover	**0.037**	3.15	**0.040**	3.26	**0.040**	3.27
$ret_{i,t-1}$	**-0.014**	-4.09	**-0.015**	-4.42	**-0.156**	-4.47
$mifid_{i,t}$	**-0.001**	-20.30	**-0.001**	-17.52	**-0.002**	-16.27
$eu_{i,t}$	**0.001**	4.40				
$mifid_{i,t} * ret_{i,t-1}$	-0.004	0.76	0.002	0.49	0.001	0.12
$eu_{i,t} * ret_{i,t-1}$	-0.000	-0.01	-0.000	-0.06	-0.000	-0.08
$mifid_{i,t} * eu_{i,t} * ret_{i,t-1}$	-0.025	-1.96	-0.026	-2.02	-0.025	-1.96
Std. Errors	Robust		Firm-clustered		Firm-clustered	
Firm fixed effects	No		Yes		Yes	
Time fixed effects	No		No		Year-Month	
Adj. R-squared	0.1%		0.3%		0.32%	
F-stat (robust)	611.16		90.57		103.91	
N. Observation	2,193,715		2,193,715		2,192,897	