Regulation and stock market quality:
The impact of MiFID II provision on research unbundling

Giulio Anselmi
Università Cattolica del Sacro Cuore
giulio.anselmi@unicatt.it

Giovanni Petrella
Università Cattolica del Sacro Cuore
giovanni.petrella@unicatt.it

International Review of Financial Analysis, Forthcoming

This Draft: 19 April 2021

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. We find that the payment of an explicit price for research is associated with a reduction in analyst coverage in the EU. Unexpectedly, the reduction is stronger for large-cap stocks. For mid- and large-cap stocks analyst coverage in the EU is still greater than in the US. The reduction in analyst coverage observed in the EU is part of a downward trend that initiated prior to MiFID II and contributes to close the gap between the two regions. We also find no change in the bid-ask spread for small-, mid- and large-cap stocks, and a slight increase for micro-cap stocks. We observe no significant change in price efficiency. Taken together our findings seem to suggest that there was an overproduction of research in Europe with the previous regulatory regime. However, the growth of passive management and index funds may also explain the observed decrease in coverage.

Keywords: MiFID II; analyst coverage; sell-side research

JEL Classification Codes: G14, G24, G28

1. Introduction

The second directive on markets in financial instruments (MiFID II), approved by European Parliament and Council in May 2014, is in effect since January 3rd, 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, following MiFID II introduction, analyst research needs to be explicitly priced and sold through specific agreements, potentially resulting in severe reductions of research reports available for asset managers[1]. This might also imply a reduction in the quality of the available information set for market participants.

Prior to MiFID II the cost of research in Europe was actually cross-subsidized by trading commissions and was not disclosed explicitly and clearly. Trading commissions were in fact passed onto asset managers' clients (i.e., fund investors) discounting them from funds' assets and performance. End investors were often unaware of the embedded research cost.

MiFID II was introduced as a tool to mitigate conflict of interest between asset managers and their clients, assuring a stronger protection for end-investors. Although the purpose of the unbundling is to promote transparency into the commission fee structure, this innovation may also lead to unintended consequences such as an increase in information asymmetry (Jensen and Meckling (1976) and Mola et al. (2013)) as well as a decrease in market efficiency (Li (2020))[2].

A vivid debate is ongoing on the effects of this provision. According to a survey realized by CFA Institute (2019) about the impact of MiFID II, 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

[1] The Financial Times recently pointed out the large difference in research budgets between EU and US asset managers due to MiFID II impact ("Mifid II influence spreads beyond EU borders", FT, May 3, 2020).

[2] The uncertainty about 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). On 17 February 2020 the European Commission opened a consultation on research unbundling and other provisions of MiFID II available at: https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/2020-mifid-2-mifir-review-consultation-document_en.pdf. In the US as well, the SEC is monitoring the impact of the European research unbundling rule. On November 9, 2019 the SEC issued a letter to assist US market participants in their engagement with the new EU rules relating to research where it was stated that its staff would have continued "to monitor and assess the evolving impact of MiFID II and evaluate whether any additional guidance or recommendations to the Commission for regulatory actions are appropriate". The SEC letter is available at: https://www.sec.gov/investment/sifma-110419.

mixed results on research quality, as 48 (17) percent of buy-side (sell-side) professionals believe that research quality is unchanged, and 27 (44) percent believe is actually decreased[3]. When the survey looks at 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.

The concerns of survey's participants might have actual reasons: as research fees are unbundled from trading fees, sell-side brokers need to reorganize their research activity and focus their efforts on more liquid stocks, which provide most of the order flow originated by buy-side firms. Whether this reorganization of sell-side brokers would result in a reduction in analyst coverage and hamper stock market quality is an empirical issue that – in our opinion – is worth studying. Assessing if the institutional framework stimulates an appropriate level of coverage is everything but trivial, as high coverage promotes firm external financing but excessive coverage might actually deliver overinvestments (Doukas et al. (2008)) and mispricing (Doukas et al. (2005)).

This study has also two additional motivations from a theoretical perspective. A first motivation is based on the theory of financial intermediation and concerns specifically the mitigation of conflicts of interest. The explicit payment for research reduces conflicts of interest among the different agents (i.e., investors, asset managers, research analysts) and increase competition across analysts. However, as a byproduct of this regulatory change we could incur in lower research coverage (and the risk of higher information asymmetry) if the research available prior to MiFID II was already optimal in terms of coverage. Unbundling introduces an explicit price for the information provided by analysts and is potentially able to disentangle the conflict of interest between investors (who pay for the research) and asset managers (who use the research), promoting competition across analysts and increasing estimates' accuracy. An explicit price for research enables investors to assess the cost-effectiveness for the services they pay for, and enables us to verify whether the research produced prior to MiFID II was actually redundant. We expect to find an overproduction of research prior to MiFID II.

A second motivation for our study is to provide empirical evidence on the relationship between analyst coverage, asymmetric information and price efficiency. Analyst research is

[3] 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 from 48 to 38 percent.

considered a public good, which may reduce information asymmetry between sophisticated and unsophisticated investors (Amiram et al. (2016)). Nevertheless, the introduction of MiFID II does not affect unsophisticated investors only. A net reduction in the provision of research as public good because of MiFID II would consequently imply an uncertain impact on the overall market efficiency[4]. However, if MiFID II increases competition across analysts as suggested by Fang et al. (2020), research would be more informative, and this would imply higher information efficiency. The actual outcome of this process is worth investigation.

This paper addresses two research questions. First, we provide quantitative evidence on the production of analyst reports following the introduction of MiFID II. Second, we examine the impact of the research fee unbundling provision on secondary market quality, as measured by stock liquidity and price efficiency. This second question intends to verify whether a decrease in analyst coverage might cause a deterioration in liquidity and efficiency. The combined understanding of the two questions will shed more light on the optimal level of analyst coverage and assess the impact of a new regulatory regime on market functioning.

The contribution of this paper is threefold. First, we provide a comprehensive assessment of the impact of the research fee unbundling provision introduced by MiFID II. Guo and Mota (2020) investigate the effects of the unbundling provision only on the production of research. We also assess the impact of MiFID II on market efficiency and liquidity, that are fundamental indicators of market quality. Our paper therefore evaluates the impact of the new regulatory regime on how markets perform their fundamental functions. This also allow us to provide additional evidence on the relationship between analyst coverage and market quality.

Second, we are also able to assess whether the quantity of research available prior to MiFID II was in excess of the optimal one. Symmetry in information, analyst coverage and efficiency of the markets constitute a well entangled trio, with a positive relationship between analyst coverage and market efficiency reported by Brennan et al. (1993), Bhattacharya (2001), Elgers et al. (2001) and Chung and Jo (1996). However, the relationship between analyst coverage and market efficiency cannot be interpreted as a positive and linear function:

[4] On the one hand, the lower participation by unsophisticated investors might imply a reduction in trading volume and, in turn, a reduction in market efficiency. On the other hand, a reduction in unsophisticated investor participation could actually drive market efficiency up as they act as noise traders (see Barber and Odean (2000), Han and Kumar (2013) and Banerjee et al. (2018)). Additionally, according to a strand of literature, such as Kelley and Tetlock (2017) and the references therein, retail short sellers are informed. Therefore, the introduction of MiFID II should also be investigated with respect to the impact on different types of investors.

e.g., Doukas et al. (2005) find a worsening of the price discovery process, with market valuation dwarfing fundamental value, when stocks experience excessive analyst coverage. Our study examines if a loss of market efficiency takes place after MiFID II introduction. By doing so, we provide evidence – which was unavailable – on the optimality of analyst coverage before MiFID II introduction. The second contribution of this study is especially relevant as it is not clear if the quantity of research available prior to MiFID II was in excess of the optimal one – as the costs were borne by investors and not by users – and the quality of research was biased by the size of trading commissions flow (Harford et al. (2018)).

Third, we provide an in-depth investigation of the impact of the research unbundling provision on small caps. Previous research shows that it is difficult for small-cap stocks to attract analyst coverage (Bradley et al. (2003)), especially in period of brokerage firm retrenchment (Fortin and Roth (2007)). Fang et al. (2020), who examine the unbundling provision, do not differentiate their analysis by firm size. By contrast, this is a particularly sensitive issue. Small caps analyst coverage concerns regulators in Europe[5] and the United States[6], as well as the industry[7]. In short, we provide evidence that was not available and concerns a relevant issue.

Our main findings suggest that MiFID II introduction reduces analyst coverage in the EU. Unexpectedly, the reduction is stronger for large cap stocks, whereas the low share of commissions generated by small-cap stocks would have actually suggested to sell-side analysts to reduce their efforts on small-cap coverage. For mid- and large-cap stocks analyst coverage in the EU is still greater than in the US. The reduction in analyst coverage in the EU is part of a long-term downward trend, initiated prior to MiFID II, that contributes to close the gap between the two regions. We find no change in liquidity for all the stocks except those with market capitalization below 300 million euros. We also find no significant deterioration

[5] The public consultation launched by the European Commission, referred to in the footnote 2, also asks for stakeholder views on increasing the production of research on SMEs, including alternative ways of its financing and ways to promote access to such research.

[6] The US House of Representatives passed a Bill on July 9, 2019 requiring the Securities and Exchange Commission (SEC) to study the provision of investment research for small issuers.

[7] 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. A decrease in analyst coverage is also suggested by investor relations officers, who believe that small caps are the most affected by this issue. Citigate Dewe Rogerson's 11th Annual Investor Relations survey, which is based on enquires to 242 European investor relations officers in 2019, shows that 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.

in price efficiency. Taken together our findings suggest that the information set available to investors is not hampered by the research unbundling provision: market makers do not increase their spread to avoid trading in higher information asymmetry and the price discovery process is not crippled. Hence, we can conjecture that prior to MiFID II there was an overproduction of research in Europe and an excess of coverage. However, the growth of passive management and index funds may also explain the observed decrease in coverage[8].

The remainder of this paper is organized as follows: Section 2 summarizes previous related papers, Section 3 presents testable hypotheses and research design, Section 4 describes the sample, Section 5 shows the results of our empirical analysis and Section 6 concludes.

2. Previous literature

One of the earliest studies that finds a positive association between analyst coverage and stock liquidity is Roulstone (2003). The paper suggests that analyst coverage provides public information to the market and promotes a reduction in the adverse selection components of the bid-ask spread. This study also finds that a low forecast dispersion in analyst estimates is associated with higher market liquidity. The evidence provided by Irvine (2003) and Balakrishnan et al. (2014) confirm a positive relationship between analyst coverage and stock liquidity, and suggest that analysts provide valuable information to outside investors and enhance stock market participation. Fang et al. (2020) examine MiFID II provisions on publicly traded firms headquartered in European Economic Area (EEA) and find a decrease in sell-side analysts covering European firms, with 334 firms completely losing their coverage. This paper, consistently with Roulstone (2003), also provides evidence that a reduction in analyst coverage produce a worsening in stock liquidity. However, this study does not differentiate the empirical analysis by firm size. Lastly, Fang et al. (2020) provides two insightful findings: an increase in competition from buy-side firms, as investors use more in-house research following MiFID II introduction, and an increase in accuracy for stock recommendations issued by sell-side analysts still active. These recommendations result as more profitable and informative (i.e., producing greater market reactions) than prior to MiFID II.

[8] Figure 1 represents graphically the assets under management by ETF in EU and US from 2015 to 2020 together with analyst coverage: a clearly negative relationship arises between the growth of passive investing and analyst coverage, possibly reflecting a lower demand for research associated with passive management.

Lang et al. (2019), who also find an increase in research quality for the analysts still active, find increased market reactions for earning announcements of EU firms relative to US firms following MiFID II adoption. They interpret this finding as a diminished information discovery role played by analysts with MiFID II as a result of the decline in analyst research, leaving more of the information content for the earning releases.

A more in-depth analysis regarding the impact of MiFID II provision on the quality of analyst recommendations is provided by Guo and Mota (2020), who find a reduction in research coverage after January 2018 and an increase in research quality, measured as a decrease in forecast error in EPS estimates by analyst. Their evidence suggests an enhancement of analyst competition driven by research unbundling and a drop out for inaccurate analysts, with only better-quality research being left in the market. By contrast, Hong and Kacperczyk (2010) and Merkley et al. (2017) propose that a general reduction in coverage quality implies a decrease in competition, as analysts feel a decrease in peers' pressure. When the effect on MiFID II provision is investigated with respect to firm-specific characteristics, the evidence shows that a decrease in coverage mostly affects large (Guo and Mota (2020) and Lang et al. (2019)), oldest and less volatile firms (Lang et al. (2019)).

On the information-production role of analysts, Kelly and Ljungqvist (2012) provide evidence showing that an exogenous reduction in analyst coverage increases information asymmetry. This finding is extended by Li (2020), who documents a tight relationship between information asymmetry and analyst coverage misvaluation. By contrast, Doukas et al. (2005) provide evidence for overvaluation when analyst coverage is excessive.

Analyst coverage and trading volume are strongly interrelated. Liu and Yezegel (2020) study the impact of the unbundling provision on trading volume generated by research, and compare trading volume for recommending broker with the trading volume of non-recommending brokers. They believe that, if unbundling is effective, we should observe lower trading volume for the recommending brokers in the post-MiFID II period. The authors find that the trading volume generated by the brokers that issued recommendation revisions declined significantly after the introduction of MiFID II while the overall trading volume response to revisions remains the same. Furthermore, they find that the value of recommendation revisions did not change while forecast accuracy improves, suggesting that MiFID II helped leveling the playing field between brokers and independent research providers. Their results, collectively, suggest that MiFID II was effective in separating research and execution services without significantly hurting the quality of sell-side equity research.

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. They 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.

As this paper investigates the impact of the MiFID II unbundling provision this literature review also considers the papers concerning the previous regulation (i.e., MiFID I). In fact, MiFID II is the regulatory regime, following MiFID I, introduced in Europe to further strengthen the three key elements essential for improving the quality of securities markets (i.e., transparency, investor protection, and competition).

With reference to the introduction of MiFID I in November 2007, Aghanya et al. (2020) find that both stock liquidity and price efficiency is higher post-MiFID I, with stock prices reflecting a larger share of firm-specific information. Christensen et al. (2016) also find an increase in stock liquidity but mostly in EU countries with high regulatory quality and stricter implementation and enforcement of the regulation. On a broader perspective Cummings et al. (2011) analyze 42 different stock exchanges and find that trading activity is related to specific regulations concerning insider trading and market manipulation. They find no impact associated to the rules relating to broker–agency conflicts, which are more similar to the unbundling provision than the regulation on insider trading and market manipulation.

The findings of previous studies show a decrease in analyst coverage after MiFID II introduction and an increase in accuracy for analyst forecasts. However, previous studies do not suggest a uniform understanding of the relationship between analyst coverage, on one side, and information asymmetries, stock liquidity and price efficiency, on the other side.

Additionally, current literature does not address the optimality of the pre-MiFID II level of analyst coverage. MiFID I introduction produced an increase in liquidity by acting on transparency and investor protection. MiFID II unbundling provision also promotes transparency, particularly in the payment for research. The impact of the MiFID II provision on liquidity and efficiency is investigated in this study.

3. Research design

3.1. Hypotheses development

Prior to MiFID II asset managers had access to a large amount of analyst research without paying for it, as research was cross-subsidized by trading commissions charged to fund investors. The new regulatory regime introduced by MiFID II requires that asset managers have to pay explicitly for research. This implies that asset managers will probably only subscribe to part of the research that they were used to receive prior to MiFID II, pursuing a more cost-effective use of analyst research and relying more on in-house analysis.

This budgeting behavior by asset managers would produce one of the following two scenarios. In the first scenario the quality of information available to market participants drops and the asymmetry of information between sophisticated and unsophisticated investors increases as a consequence of the general reduction in research production. Alternatively, in the second scenario the quality of information remains stable and the reduction in coverage affects only analysts with low marginal value, crowding out less competitive players, as asset managers stop buying research that they do not value.

If the first scenario (i.e., a worsening of the information set) holds true, we should observe an overall deterioration of liquidity and price efficiency. On the other hand, if the second scenario (i.e., no worsening of the information set) holds true, we should observe no harm to liquidity and price efficiency, as the increased competition forces out only less accurate analysts that do not provide marginal contribution to the overall set of information nor influence the price discovery process.

Guo et al. (2020) find that MiFID II introduction does not reduce the quality of analyst estimates. We extend their analysis and check whether MiFID II affects market liquidity and price efficiency. In this respect Fang et al. (2020) observe that with MiFID II the quality of analyst estimates increases together with the price impact of analyst estimates. This might be interpreted as estimates conveying more relevant information to investors or as evidence of a decrease in market liquidity. If we observe a decrease in analyst coverage followed by no impact on market quality, we would need to consider carefully the overproduction hypothesis for the European market: as analyst research becomes costly to asset managers, sell-side firms focus their effort where they can make a difference, neglecting stocks where their marginal contribution is limited. This would probably imply that most of the decrease in coverage appears in large cap stocks, where the number of analysts per stock is the highest. For small- and mid-cap stocks, where the number of analysts per stock is lower, the probability of overproduction is also lower and sell-side analysts might act as specialized agent conveying a greater marginal contribution to market informativeness. If this is the case, the research unbundling provision of MiFID II introduces greater transparency in the fee structure without unintended harmful consequences.

Figure 2 depicts the overall framework for sell-side brokers, buy-side managers and end-investors prior to and after MiFID II introduction for the scenarios described above.

As stated in the introductory section, the goal of this study is twofold. First, we study the effects of MiFID II introduction on analyst coverage. Second, we wish to examine the impact of the research fee unbundling provision on secondary market quality, particularly on stock liquidity and price efficiency.

In order to address our first research question 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. This approach is consistent with Doukas et al. (2005), Fang et al. (2020), Guo and Mota (2020), Lee and So (2017) and Li (2020).

Based on the expectations of market participants (ICMA (2019)) we test whether 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, which produce only a small fraction of the order flow brokers' commissions. The explicit payment for research adds a new constraint on buy-side firms' budget and stimulates investors to rely less on sell-side research and more on in-house research (Fang et al. (2020)). This change in preferences is amplified if sell-side research received by buy-side firms is deemed as redundant. Following the adjustment in buy-side firms' budget, sell-side firms will probably experience a reduction in revenues. We therefore expect a transition of analysts' coverage away from stocks providing a smaller share of commissions (i.e., thinly-traded stocks) to more profitable stocks (i.e., mid and large cap stocks). We also provide an alternative explanation in case the empirical evidence does not support the expected transition from small-cap to mid- and large-cap: we posit that level of coverage before MiFID II was excessive (i.e., the overproduction hypothesis), as analysts are not reallocated to more profitable stocks because their marginal contribution to the quality of research would be negligible.

Our first testable hypothesis is stated as follows.

Hypothesis 1 (H1): Analyst coverage, measured as the number of earning-per-share estimates produced by analysts, decreases following the implementation of MiFID II because of the new constraints on asset managers budgets and the excess of research available in the pre-MiFID II regime.

> *Hypothesis 1.1 (H1.1): The reduction in analyst coverage is stronger for small-cap stocks due to the reallocation of resources by sell-side brokers to stocks that are expected to be more profitable in terms of order flow commissions.*

Our second research question concerns the extent to which market liquidity and price efficiency are affected by MiFID II newly introduced provision on research fee unbundling. In this regard the expected impact of MiFID II is less clear than for analyst coverage. On one hand, less analyst coverage leads to higher information asymmetry (Brennan et al. (1993) and Bhattacharya (2001)), and thus decrease the market efficiency (Li (2020)), if we assume that the level of analyst coverage was optimal prior to MiFID II implementation. Moreover, if MiFID II increases transparency and lowers transaction costs, we can expect a decrease in the informativeness of stock prices due to greater participation of uninformed investors (Barber and Odean (2000), Han and Kumar (2013) and Banerjee et al. (2018)). On the other hand, Guo and Mota (2020) document that unbundling produces a drop out of inaccurate analysts and analyst who stay produce better quality research. If this is valid, we expect that MiFID II improves market efficiency as more accurate information is available in the market. This also implies that the level of analyst coverage prior to MiFID II was sub-optimal.

To test this hypothesis we use as liquidity proxy the stock bid-ask spread at monthly frequency and, for price efficiency, the autocorrelation of daily stock's return as well as the delay in the price discovery process from Hou and Moskowitz (2005). We investigate whether the unbundling provision cause an increase in information asymmetry and a worsening of stock liquidity, via an increase in bid-ask spread, and a worsening of price efficiency, via a departure from the absence of autocorrelation in return required by the random walk assumption.

We also test whether small-cap firms experience a larger worsening in market quality than mid- and large-caps. We expect that the market quality for small-cap stocks is the most affected by a drop in coverage (H1.1) and the hampering in information provision is passed to efficiency and liquidity. Our further hypotheses are therefore the following: hypothesis 2 tests for stock liquidity and hypothesis 3 tests for price efficiency.

Hypothesis 2 (H2): Stock liquidity, measured as percentage bid-ask spread, decreases following the implementation of MiFID II because of the greater information asymmetry due to the reduction in analyst coverage.

Hypothesis 2.1 (H2.1): The reduction in liquidity is stronger for small-cap stocks, which are more sensitive to asymmetric information.

Hypothesis 3 (H3): Price efficiency, measured as autocorrelation in stock returns, decreases following the implementation of MiFID II because of the greater information asymmetry due to the reduction in analyst coverage.

Hypothesis 3.1 (H3.1): The reduction in efficiency is stronger for small-cap stocks, which are more sensitive to asymmetric information.

3.2. Econometric specification

We perform our empirical analysis in a difference-in-difference (DD) framework. We compare a European sample undergoing the implementation of MiFID II (Treatment sample) with a non-EU sample (Control sample) whose stocks do not fall under MiFID II application perimeter. For H1 we employ the following model:

$$\begin{aligned} analyst_{i,t} = \alpha_0 + \alpha_1 mifid_t + \alpha_2 eu_i + \alpha_3 (mifid_t * eu_i) + \alpha_4 mktcap_{i,t} + \alpha_5 turn_{i,t} \\ + \alpha_6 volatility_{i,t} + \alpha_7 freefloat_{i,t} + \alpha_8 inst_{i,t} + \alpha_9 short_{i,t} + \alpha_{10} r_{i,m,t} \\ + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where $analyst_{i,t}$ represents the number of EPS estimates published by analysts for stock i in month t, $mifid_t$ is a dummy variable which takes value of 1 for any month after January 2018, eu_i 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. As control variables we include the following: $mktcap_{i,t}$ is the natural logarithm of market capitalization, $turn_{i,t}$ is the traded volume for stock i in month t as percent of market capitalization (i.e., turnover or turnover velocity), $volatility_{i,t}$ is the historical daily volatility for stock i in month t and intercepts riskiness of the stocks, $freefloat_{i,t}$ is the percentage of free-floating shares and serves as a proxy for dispersed ownership which is expected to affect liquidity (Ding et al. (2016)), $inst_{i,t}$ is the fraction of ownership belonging to institutional investors, $short_{i,t}$ is the ratio between the overall number of institutional investor short selling the stock and the number of institutional investors long the stock, and $r_{i,m,t}$ is the monthly return for the market m where stock i is listed.

For H2 the model is the following:

$$\begin{aligned} spread_{i,t} = \alpha_0 + \alpha_1 mifid_t + \alpha_2 eu_i + \alpha_3 (mifid_t * eu_i) + \alpha_4 mktcap_{i,t} + \alpha_5 turn_{i,t} \\ + \alpha_6 volatility_{i,t} + \alpha_7 freefloat_{i,t} + \alpha_8 inst_{i,t} + \alpha_9 short_{i,t} + \alpha_{10} r_{i,m,t} \\ + \varepsilon_{i,t} \end{aligned} \qquad (2)$$

where $spread_{i,t}$ is the average monthly bid-ask spread for stock i in month t.

In order to assess price efficiency after MiFID II introduction (H3), we rely on the usual Fama (1991) model and the delay measure proposed by Hou and Moskowitz (2005). We test whether the predictability of stock returns increases after January 2018 via a difference-in-difference-in-difference (DDD) model (also known as triple diff or triple interaction estimator) as shown by Imbens and Wooldridge (2007). For this analysis we employ daily data. The following equation presents the Fama (1991) model in the DDD framework used to test for H3:

$$ret_{i,t} = \alpha_0 + \alpha_1 mifid_t + \alpha_2 eu_i + \alpha_3 ret_{i,t-1} + \partial_1(mifid_t * eu_i) + \partial_2(mifid_t * ret_{i,t-1}) + \partial_3(eu_i * ret_{i,t-1}) + \partial_4(mifid_t * eu_i * ret_{i,t-1}) + \alpha_4 mktcap_{i,t} + \alpha_5 turn_{i,t} + \alpha_6 volatility_{i,t} + \alpha_7 r_{i,m,t} + \varepsilon_{i,t} \quad (3)$$

where $ret_{i,t}$ is the daily log-return for stock i and date t, coefficients α_1 and α_2 represent the differential effect on daily log-returns of observations, respectively, following January 2018 (i.e., in the MiFID II regime) and belonging to European stocks (i.e., the Treatment sample). Coefficient ∂_1 captures the interaction between the two latter time and state variables and represents our original DD technique. However, the main coefficient of study is now ∂_4, as it captures the effect on the price discovery process of stocks undergoing treatment (DDD). We expect a coefficient statistically significant and different from zero if price efficiency is hampered. On the other hand, if the coefficient is not significant, we can conclude that no alteration in price efficiency occurs once MiFID II becomes effective[9].

Moving to our second measure of price efficiency, we use the following delay measure proposed by Hou and Moskowitz (2005):

$$delay_{i,t} = 1 - \frac{R^2_{restriced}}{R^2_{unrestricted}}$$

where $delay_{i,t}$ is the ratio of the two R-squared coefficients estimated for a restricted model and an unrestricted model with $ret_{i,t}$ as dependent variable and $r_{i,m,t-1}$ and its lagged values as explanatory variables. This measure implies that price efficiency is higher when new information is rapidly incorporated into prices and the difference in explanatory power between restricted model and unrestricted model decreases. The $delay_{i,t}$ measure decreases as price efficiency increases. The following model tests price efficiency with the delay measure in a DD framework:

$$delay_{i,t} = \alpha_0 + \alpha_1 mifid_t + \alpha_2 eu_i + \alpha_3(mifid_t * eu_i) + \alpha_4 mktcap_{i,t} + \alpha_5 turn_{i,t} + \alpha_6 volatility_{i,t} + \alpha_8 r_{i,m,t} + \varepsilon_{i,t} \quad (4)$$

[9] To deal with heteroskedasticity and serial correlation, we clustered standard errors at firms' level and we implemented firms fixed effect and time-month fixed effect as suggested by Petersen (2009).

4. Data description

We collect monthly data for 10,575 stocks traded from major European Union stock markets and other non-EU stock markets, via Thompson Reuters, Bloomberg and I/B/E/S for four years across MiFID II introduction, from 2015 to the end of 2019.

The sample includes all stocks actively traded during the sample period available on I/B/E/S archive after filtering for errors in earning-per-share analyst recommendations and bid-ask spread variables. We focus our analysis on stocks with at least one analyst covering the stock throughout the entire sample period. we believe that initiation of coverage and complete loss of coverage are events that involve too many different moving parts. The presence of stocks undergoing such events would mix up obscure our analysis. We therefore exclude stocks with a loss of coverage/initiation of coverage from the sample to avoid noise from idiosyncratic issues such as deterioration in liquidity (see Mola et al. (2013)) and alteration in price efficiency (see Demiroglu and Ryngaert (2010)).

For each stock in the sample we collect end-of-the-month trade price, average bid and ask quotes and the variables previously indicated. We then exclude stocks without analyst estimates throughout the period, missing values and bid-ask spread values above the 95^{th} percentile. The resulting sample contains 9,000 stocks and 332,701 firm-month observations. The sample for analyst coverage is split into 2,352 EU stocks (89,799 obs) and 6,648 non-EU stocks (242,902 obs). The sample is composed by one-third of EU stocks and two-thirds of non-EU stocks. Table 1 presents the sample by country, Table 2 reports the description of the variables and Table 3 presents main descriptive statistics for the sample.

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 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 (field name EPS1NE)[10]. In order to verify the reliability of this measure we also check the correspondence between

[10] 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.

number of EPS estimates and number of analysts. Figure 3 provides an example of the EPS estimates breakdown by analyst. As control variables we employ stock market capitalization and traded volume.

Figure 4 and Figure 5 represent, respectively, analysts' coverage and bid-ask spread for the entire sample period for Treatment and Control groups. As shown by Figure 4, the average number of analysts for Treatment is above 7 before the introduction of MiFID II and drops to less than 6 after January 2018, showing a general reduction of analysts' coverage for European stocks. The average number of analysts for the Control sample is below 7.5 at the beginning of 2015 and drop by almost 1 analyst after MiFID II. Figure 4 shows a gap in analyst coverage between EU and non-EU stocks, that widens in 2018 and closes in 2019. As for liquidity, Figure 5 shows a larger bid-ask spread for EU stocks with respect to non-EU ones, with a slight increase in this gap from January 2018.

Table 3 presents the descriptive statistics for the entire sample and Table 4 presents the pairwise correlation coefficient of our main variables. The average market capitalization of the sample is 5.03 billion euros with a high standard deviation of 20.99 billion euros, a 25th percentile at 119 million euros and a 75th percentile at 2.5 billion euros. The average market capitalization of European stocks is about 3 billion euro whereas the market capitalization for non-European firms is above 6 billion euros. In terms of heterogeneity of the sample market capitalization shows a coefficient of variation of 4.2, that becomes 0.36 when we consider the natural logarithm transformation.

The average number of analysts that publish an estimate on earning-per-share is 6.7 for the entire sample. We observe almost the same level of coverage between groups: European stocks show an average of 6.4 analysts per stock and non-EU stocks display an average of 6.8 analyst per stock. The standard deviation for the entire sample is 6.9 analysts, the 25th percentile has 2 analysts per stock and the 75th percentile has 9 analysts. The top fifth percentile is covered by at least 22 analysts, that become 23 if the stock is European and 21 if non-EU. Although the level of coverage for the 95th percentile is almost identical between Treatment and Control groups it is worth considering the difference in terms of size, with European stocks having an average capitalization of 13 billion euros and non-EU stocks 26 billion euros. Further descriptive statistics on sub-samples by market capitalization are provided in Table 5. The average bid-ask spread is 83 bps for the full sample. EU stocks display higher execution costs than non-EU stocks, with an average bid-ask spread of 163 bps with respect to 45 bps.

Table 5 presents the descriptive statistics for analyst coverage and bid-ask spread when the overall sample is partitioned by market capitalization. We split the sample into four different sub-samples according to the following thresholds: “micro-cap” when stock market capitalization is below 300 million euros, “small-cap” when the market capitalization is between 300 and 1,000 million euros, “mid-cap” for stocks with market capitalization between 1 and 3.5 billion euros and “large-cap” for stocks with market capitalization greater than 3.5 billion euros. As expected, analyst coverage increases (and bid-ask spread decreases) in market capitalization. Small-cap stocks presents 2.2 analyst per stock in the full sample (1.8 in Treatment and 2.4 in Control samples). For the first three sub-samples in terms of market capitalization the average coverage for EU and non-EU stocks is pretty similar, with mid-cap stocks being covered on average by 7.4 analysts (8.5 if they are from EU and 7.1 if they are from non-EU). However, when we consider large-cap stocks we document a difference with respect to previous sub-samples: large-cap EU stocks are covered on average by almost 18 analysts, whereas non-EU stocks with the same market capitalization are followed by 12.3 analysts on average.

As for bid-ask spread, the full sample presents an average value of 129 bps for small-cap stocks. We observe a gap between Treatment and Control groups: EU stocks show a sensibly higher cost of trading, with 195 bps compared to 82 bps for non-EU stocks. This gap in trading cost shrinks to 20 bps for mid-cap stocks (35 bps for Treatment and 15 bps for Control) and almost disappears for large-cap stocks. The comparison between EU and non-EU stocks shows a lower analyst coverage for EU small caps with respect to non-EU stocks. The result is reversed and amplified when we consider large-cap stocks. When we consider trading cost, the comparison between EU and non-EU stocks shows higher costs for EU stocks, although the gap is decreasing as market capitalization increases. The behavior over time for analyst coverage and liquidity is also described in Figure 8 and Figure 9.

5. Results

5.1. Analyst coverage

Our empirical analysis is based on a DD technique. We compare analyst coverage for European and non-European stocks before and after the introduction of MiFID II unbundling provision regime. Table 6 shows the estimation results for Equation (1), where the dependent variable is the number of EPS estimates published by analysts. In model specification M1 we estimate a model with year-month fixed effects and find that the coverage of European and non-European stocks – controlling for long term trend – actually increases by 0.15 EPSs following MiFID II introduction. Looking at the treatment variable, eu_i, we observe a higher coverage by 0.95 EPSs, holding constant all other covariates. This first evidence suggests that the gap we present in Figure 4 for the full sample is actually reverted, with European stocks benefiting from a higher coverage in comparison to non-EU stocks when we address the issue in a multivariate framework. However, a European stock after the introduction of MiFID II suffers from a reduction in coverage by 0.50 EPSs. The coefficient for the interaction term, $mifid_t * eu_i$, proves that after January 2018 European stocks have experienced a reduction in the number of analysts that provides estimates in comparison to non-EU stocks.

To study the evidence in a broader framework, it is helpful to consider the results for the time fixed effects model. The estimation of this model shows the development of analyst coverage throughout the years. We observe a common decreasing long-term trend for coverage that initiated before January 2018 and increased in magnitude after MiFID II introduction for European stocks.

Jin and Myers (2006) show that countries with greater transparency have more informative stock prices and Djankov et al. (2003) suggest that the effectiveness of regulatory changes can be significantly influenced by the existing regulatory environment. Hence country-based pre-existing regulation might alter our results and mistakenly describe a widespread effect of MiFID II unbundling provision across the entire Union. Then, in order to study whether different regulation among countries might affect our results, we also include country fixed effects in model specification M2. The estimation of this model provide evidence that our intuition is grounded: a widespread reduction in analyst coverage for European stocks takes place after January 2018, with the coefficient for $mifid_t * eu_i$ stable at -0.5 estimates. Lastly, in model specification M3 we stress our analysis with the inclusion of firm fixed effects, so that we saturate the model for idiosyncratic features unrelated with our topic. Results are confirmed when firm fixed effects are considered[11]. Hence, although a decreasing trend in analyst coverage was already in place in recent years, MiFID II introduction reinforces a downward pressure. The payment of an explicit price for research promotes a cost-effective use of analyst services, in the midst of a widespread reduction in analyst coverage.

[11] The coefficients estimated for control variables display the expected signs: analyst coverage is increasing in market capitalization, free float, and institutional investors.

After having found that our results are homogenous among countries, we investigated if they are also homogenous across market capitalization and we performed the analysis on four different sub-samples according to market capitalization. Our main interest lies in the effect that MiFID II introduction have on analyst coverage for small-cap stocks. We expect a relative larger loss in coverage for less capitalized stocks (H1.1) due to dependency of sell-side brokers commission fees on the order flow that they process. Hence, in times of increasing budget constraints due to the explicit payment for research, analyst coverage might be reallocated to larger – and more profitable (as they are associated with larger order flow) – stocks. In order to test H1.1 we split our sample into four different sub-samples according to market capitalization: stocks with market capitalization less than 300 million euros are defined "micro-cap", stocks with market capitalization between 300 and 1,000 million euros are "small-cap" stocks with market capitalization between 1 and 3,5 billion euro are "mid-cap" and stocks with market capitalization greater than 3,5 billion euros are "large-cap". We then perform a regression analysis by sub-samples following Equation 1 with time fixed effects and without country fixed effects. We rely on M1 model specification because once we understand that (partially) different European country market regulation does not add useful information to our model (as shown by M2 in Table 6) we implement a full specification for the DD methodology where the coefficient α_2 is not omitted and captures the effect on the dependent variable when the stock is European. Results are displayed in Table 7. The first specification (M4) studies the effect of MiFID II implementation for micro caps and the coefficient for the interaction term evidences a small increase, 0.097, in coverage after January 2018. For the small cap sample (M5) we notice a decrease in analyst coverage by 0.20 for European stocks after MiFID II introduction and the model suggest no significant difference in coverage between treated and control group before January 2018. Mid-cap and large-cap stocks present respectively a decrease in analyst coverage of 0.64 and 1.58 for European stocks after MiFID II introduction and both models show a greater coverage for European stocks before undergoing treatment, with European mid-cap (large-cap) stocks benefit from 1.94 (5.24) more estimates than their non-EU counterparts.

For a thorough understanding of the long-term trend in analyst coverage it is useful to consider the number of estimate available for each sub-sample before MiFID II. European small caps account on average on 3.90 analysts for the period prior January 2018, mid-caps account for 8.47 and large-caps 17.78. In percentage points the additional reduction of analyst coverage from $mifid_t * eu_i$ is 5.23 for small-cap, 7.53 for mid-caps and 8.91 for large-caps, suggesting that the weight of the reduction is heavier as market capitalization increases. Therefore, H1.1 is rejected as small-cap stocks do not suffer from a larger reduction in analyst coverage than mid- and large-cap stocks.

5.2. Market liquidity

After we addressed the impact of MiFID II on analyst coverage, we verify the effects of MiFID II on market quality and more particularly whether or not the new regulation hampers liquidity. The investigation of the effects of MiFID II unbundling regime on market liquidity is the step following the understanding of its effects on analyst coverage, as a decrease in coverage initiated by the new regulation could increase information asymmetry pushing away traders form the market and resulting in a decrease in liquidity.

Table 8 presents our results for the liquidity impact and tests hypothesis H2. As for the previous hypothesis we estimate three model specifications on the full sample, with year-month fixed effects (M8), year-month-country fixed effects (M9) and year-month-firm fixed effects (M10). All three model specifications suggest an increase of 10 bps in the bid-ask spread for European sample after MiFID II introduction, with M8 showing pre-treatment trading costs for European stocks already higher by almost 52 bps than non-EU stocks[12]. This evidence suggests that, on a full sample basis, we experience a decrease in liquidity for European stocks following MiFID II introduction. This result, although interesting, is not yet sufficient to offer a complete understanding of the phenomena.

Next, we perform the analysis by market capitalization sub-samples, where sub-samples are organized following the same rationale we used for H1 in Table 7. To provide robust results and following our cleansing technique for the full sample, we eliminate observations with bid-ask spread above the 95th percentile on each sub-sample, as presented in Table 5. Table 9 provides our results on market liquidity for sub-samples. We observe pre-treatment trading costs for European stocks – ranging from 6 to 55 bps – higher than non-EU stocks, regardless of their market capitalization. Looking at the interaction term, European micro caps sub-sample is the only one that suffers from an increase in bid-ask spread after the introduction of MiFID II, with the cost of liquidity increasing by 6.43 bps for European micro caps after undergoing treatment (M11), whereas European stocks with market capitalization

[12] The coefficients estimated for control variables display the expected signs: the bid-ask spread is decreasing (increasing) in market capitalization, turnover, free float, and institutional investors (short interest).

above 300 million euros show no statistically significant increase in bid-ask spread after MiFID II introduction.

H2 is not rejected only for micro-cap stocks (i.e., stock with market capitalization lower than 300 million euros). When we focus on the three most capitalized sub-samples, we reject H2 and find no change in the cost for liquidity following MiFID II introduction.

These results are particularly interesting in light of the findings reported in Table 7, where the decrease in coverage for European stocks with MiFID II increases with market capitalization. One might expect that the increase in trading costs should affect more stocks with the largest loss of coverage. However, we observe no significant change in trading costs for the three most capitalized sub-samples, showing that the level of coverage prior to MiFID II introduction was probably in excess to the optimal one.

5.3. Price efficiency

Market liquidity, although a very important, only represents one dimension of market quality. We also study the price discovery process, which is another key aspect of market functioning. In order to assess if price efficiency is hampered by MiFID II introduction, we rely on a sample of 2,770 stocks and circa 2.3 million of daily observation from European and non-European stocks. Table 10 shows the estimation results for our model presented in Equation 3, where we employ the usual Fama (1991) model in a DDD framework. Model specification M14 tests the first-order autocorrelation of daily returns with covariates and time fixed effects. Based on the triple interaction term ∂_4 it is possible to assess whether the influence of $ret_{i,t-1}$ increases in magnitude after January 2018 for European stocks. Coefficient ∂_4 present a minor statistically significance suggesting a possible alteration of price efficiency after MiFID II introduction for European stocks[13]. Table 10 presents also model specification with additional country and firm fixed effects and results still suggest weak significance for deterioration in price discovery process.

As for H1 and H2 hypotheses we observe that the full sample analysis provides only an overall description of the phenomena. To assess possible differential effects across stocks, we partition the full sample into four different subsamples according to market capitalization. This is the same partitioning procedure that we apply for H1 and H2, and results are shown in

[13] We expand our analysis by including additional lags in our model for M14. This expanded specification does not affect the statistical significance of the coefficient for the variable $mifid_t * eu_i * ret_{i,t-1}$.

Table 11. When the sample is partitioned by market capitalization the weak statistical significance we evidence for ∂_4 for the full sample is no more present, and none of the sub-samples suffer from a price discovery deterioration for stocks undergoing treatment.

When price efficiency is measured by $delay_{i,t}$ we rely on an unrestricted market model with one week of daily lagged returns:

$$ret_{i,t}^{unrestricted} = \alpha_0 + \alpha_1 r_{i,m,t} + \sum_{j=1}^{4} \beta_j r_{i,m,t-j}$$

We then estimate three distinct pairs of time-series regressions for restricted and unrestricted market model on each stock i, with rolling windows of observations equal to three months, six months and one year. We therefore provide three different time series of $delay_{i,t}^{w}$ with w being equal to 60, 120 or 180, based on the number of trading days in each time series regression. This approach allows us to reach more robust results and a more comprehensive understanding of the price discovery process after MiFID II introduction.

Table 12 shows that European stocks exhibit lower efficiency than non-EU stocks regardless of MiFID II implementation, with eu_i being positive and significant. Following the introduction of the unbundling regime we observe a deterioration in the price discovery process only for mid-cap stocks, whereas we find no evidence of a decline in efficiency for large-caps, with none of the three regressions showing a significant coefficient for $delay_{i,t}^{w}$.

Summing up, the empirical analysis shows that we cannot reject our null hypothesis on price efficiency: our findings suggest that the reduction in coverage following MiFID II implementation produces no harm to the price discovery process.

5.4. Robustness check

A proper sample composition is fundamental for the robustness of our conclusions. For this reason, we check whether our findings are induced by an erroneous sample composition. We re-organize the control sample by excluding, alternatively, stocks from different countries (i.e., US and Japan). Table 13 and Table 14 present the results of this robustness check, respectively, on analyst coverage and liquidity for the full sample as well as for the large-cap sub-sample[14]. As shown in our previous analysis, the full sample suffers

[14] For the sake of conciseness, we decided to focus only on this sub-sample, being the one most affected by MiFID II introduction in terms of coverage loss.

from a loss of coverage for European stocks regardless of the control sample composition, with large-cap European stocks suffering the most. In terms of trading we also find a confirmation for the previous findings: the cost of trading increases for full sample, but the deterioration does not affect large-cap European stocks.

As a further robustness check on sample composition, we perform a DD analysis filtering the original 9,000 stocks sample according to Rosenbaum and Rubin (1983) Propensity-Score Matching (PSM) technique. We compute the expected probability of undergoing treatment based on the observations available before the introduction of MiFID II. Specifically, we rely on the following variables to assess the Probit regression: market capitalization, monthly trading volume, volatility, free float and correlation with market returns[15]. We then perform our DD analysis and report the results in Table 15. The analysis with PSM provides results similar to our previous findings for the full sample as we observe a reduction in coverage by -0.242 EPSs and an increase in bid-ask spread by 10 bps. We also perform a PSM DD analysis on the large-cap sub-sample and find a reduction in analyst coverage by 2.332 estimates and no statistically significant alteration for the cost of trading.

Secondly, we verify the robustness of our analysis checking an alternative definition of market liquidity. We rely on Amihud (2002) illiquidity measure, $aill_{i,t}$, where $aill_{i,t} = \frac{|r_{i,t}|}{turnover_{i,t}}$. Table 16 shows that illiquidity increases on a full sample basis, in line with our evidence on $spread_{i,t}$. However, again similarly to our previous finding, when the analysis focuses on sub-samples by market capitalization, the deterioration in liquidity is limited to micro-cap European stocks and does not affect stocks with market capitalization above 300 million euros.

Lastly, we provide a robustness check on H3 using the Pastor and Stambaugh (2003) model to verify the effects of MiFID jointly on liquidity and price efficiency. The following equation presents our testing model:

[15] Descriptive statistics for the PSM sample are not tabulated for sake of brevity but are available from the authors upon request.

$$
\begin{aligned}
ret_{i,t} = {} & \alpha_{0,i} + \alpha_1 mifid_t + \alpha_2 eu_i + \alpha_3 ret_{i,t-1} + \alpha_4\left(mifid_t * ret_{i,t-1}\right) \\
& + \alpha_5\left(mifid_t * eu_i * ret_{i,t-1}\right) + \gamma_1 sign\left(ret_{i,t-1}\right) * turn_{i,t-1} \\
& + \gamma_2 sign\left(ret_{i,t-1}\right) * turn_{i,t-1} * mifid_t + \gamma_3 sign\left(ret_{i,t-1}\right) * turn_{i,t-1} \\
& * eu_i + \gamma_4 sign\left(ret_{i,t-1}\right) * turn_{i,t-1} * mifid_t * eu_{i,t} + \alpha_5 mktcap_{i,t} \\
& + \alpha_6 turn_{i,t} + \alpha_7 volatility_{i,t} + \alpha_8 r_{i,m,t} + \varepsilon_{i,t}
\end{aligned} \tag{5}
$$

where $sign\left(ret_{i,t-1}\right)$ represents the direction of yesterday's stock return and γ_4 measures the price reaction (or reversal) following a shock in the trading volume in the previous day for a European stocks after MiFID II introduction. A significant estimate for γ_4 coefficient would suggest a change in price efficiency for the market after MiFID II introduction for European stocks.

Table 18 reports the estimates for Equation 5 on the full sample and Table 19 presents our results for sub-samples by market capitalization. Both Tables confirm our previous findings: we observe no change in price efficiency, as the coefficient for daily-autocorrelation in $ret_{i,t}$ is not statistically significant, and neither the magnitude nor the statistical significance of γ_4 coefficient for the full sample as well as the individual sub-samples.

6. Conclusions and further directions for research

This paper investigates the effects of the research unbundling provision introduced by MiFID II on analyst coverage and market quality. 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.

We find a reduction in analyst coverage in the EU, especially for large-cap stocks. This result is somehow unexpected: some market participants believed that sell-side brokers would instead focus their efforts on the most traded stocks, where the attention of buy-side firms is larger and discard low volume stocks.

For mid- and large-cap stocks analyst coverage in the EU is still greater than in the US. The reduction in analyst coverage in the EU is part of a downward trend that initiated prior to MiFID II and contributes to close the gap between the two regions.

We also find no change in the bid-ask spread for small-, mid- and large-cap stocks, and only a slight increase for micro-cap stocks. We observe no significant change in price efficiency for the full sample as well as for the market capitalization sub-samples.

Taken together our findings suggest that there was an overproduction of research in Europe with the previous regulatory regime. We provide evidence that the lower analyst coverage observed after MiFID II implementation did not cause a deterioration in market quality, for the largest part of our sample, in terms of price efficiency and liquidity. European stocks having a positive gap in coverage with respect to non-EU stocks prior to MiFID II introduction (i.e., large-cap and mid-cap stocks) suffer the most in terms of coverage reduction as the new regulatory regime is implemented. However, they experience no hampering in liquidity and efficiency. This evidence suggests that the previous level of coverage for European stock was sub-optimal and its reduction does not produce a harmful impact on market quality. We also posit that the growth of passive management and index funds may explain the observed decrease in coverage.

The findings of this paper raise further questions that might be worth to investigate. The structure of the research market might be strongly affected by the unbundling provision: the sell-side research market could consolidate and/or the sell-side research might migrate to the buy-side. A relevant question relates to the assessment of the overall welfare implications of the unbundling provision, taking into account jointly the impact on the costs borne by investors as well as by asset managers.

A relevant strand of literature, such as Kelley and Tetlock (2017), provide evidence that retail short sellers are more informed than institutional ones, especially when small stocks are considered. Whether the new research unbundling regime affects the informativeness of retail short sellers is a topic for future studies, as well as the impact of reports with different opinions (optimistic or pessimistic) and the effect of the new regime on price efficiency in the long-term.

References

Aghanya, D., Agarwal V. & Poshakwal S. (2020). Market in Financial Instruments Directive (MiFID), Stock Price Informativeness and Liquidity. Journal of Banking and Finance, 113, 105730.

Amihud Y. (2002). Illiquidity and Stock Returns: Cross-section and Time-series Effects. Journal of Financial Markets, 5(1), 31-56.

Amiram D., Owens E. & Rozenbaum O. (2016). Do Information Releases Increase or Decrease Information Asymmetry? New Evidence from Analyst Forecast Announcements. Journal of Accounting and Economics, 62, 121-138.

Balakrishnan, K., Billings, M. B., Kelly, B. & Ljungqvist, A. (2014). Shaping Liquidity: On the Causal Effects of Voluntary Disclosure. Journal of Finance, 69, 2237–2278.

Banerjee, S., Davis, J. & Gondhi, N. (2018). When Transparency Improves, Must Prices Reflect Fundamentals Better? The Review of Financial Studies, 31(6), 2377-2414.

Barber, B. & Odean, T. (2000). Trading is Hazardous to your Wealth, the Common Stock Investment Performance of Individual Investors. Journal of Finance. 55(2), 773-806.

Bhattacharya, N. (2001). Investors' Trade Size and Trading Responses around Earnings Announcements: An Empirical Investigation. The Accounting Review, 76(2), 221-244.

Bradley, D., Jordan B. & Ritter J. (2003). The Quiet Period Goes Out with a Bang, Journal of Finance, 58(1), 1-36.

Brennan, M. J., Jegadeesh, N. & Swaminathan, B. (1993). Investment Analysis and the Adjustment of Stock Prices to Common Information. The Review of Financial Studies, 6(4), 799-824.

Brown L. D. (1997). Analyst Forecasting Errors: Additional Evidence. Financial Analysts Journal, 53(6), 81-88.

Busch, P. & Obernberger, S. (2016). Actual Share Repurchases, Price Efficiency, and the Information Content of Stock Prices. The Review of Financial Studies, 30(1), 324-362.

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.

Chopra V. K. (1998). Why So Much Error in Analysts' Earnings Forecasts? Financial Analysts Journal, 54(6), 35-42.

Christensen H. B., Hail L. & Leuz C. (2016). Capital-Market Effects of Securities Regulation: Prior Conditions, Implementation, and Enforcement. The Review of Financial Studies, 29(11), 2885-2924.

Chung, K. H. & Jo H. (1996). The Impact of Security Analysts' Monitoring and Marketing Functions on the Market Value of Firms. Journal of Financial and Quantitative Analysis, 31(4), 493-512.

Cumming, D., Johan, S. & Li, D. (2011). Exchange Trading Rules and Stock Market Liquidity. Journal of Financial Economics, 99(3), 651-671.

Demiroglu C. & Ryngaert M. (2010). The First Analyst Coverage of Neglected Stocks. Financial Management, 39(2), 555-584.

Ding X., Ni Y. & Zhong L. (2016). Free Float and Market Liquidity Around the World. Journal of Empirical Finance, 38, 236-257.

Djankov. S., Glaeser E., La Porta R., Lopez-de-Silanes F. & Shleifer A. (2003). The New Comparative Economics. Journal of Comparative Economics, 31(4), 595-619.

Doukas J. A., Kim C. & Pantzalis C. (2005). The Two Faces of Analyst Coverage. Financial Management, 34(2) 99-125.

Doukas J. A., Kim C. & Pantzalis C. (2008). Do Analysts Influence Corporate Financing and Investment? Financial Management, 37(2) 303- 339.

Dreman D. N. & Berry M. H. (1995). Analyst Forecasting Errors and their Implications for security Analysis. Financial Analysts Journal; 51(3), 30-41.

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.

Elgers, P. T., Lo, M. H. & Pfeiffer Jr, R. J. (2001). Delayed Security Price Adjustments to Financial Analysts' Forecasts of Annual Earnings. The Accounting Review, 76(4), 613-632.

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.

Fama E. (1991). Efficient Capital Markets: II. The Journal of Finance, 46(5), 1575-1617.

Fang, B., Hope, O. K., Huang, Z. & Moldovan, R. (2020). The Effects of MiFID II on Sell-Side Analysts, Buy-Side Analysts, and Firms. Review of Accounting Studies, 25(3), 855-902.

Fong K. Y. L., Holden C. W. & Trzcinka C. A. (2017). What Are the Best Liquidity Proxies for Global Research? Review of Finance, 21(4), 1355-1401.

Guo, Y. & Mota, L. (2020). Should Information be Sold Separately? Evidence from MiFID II. Journal of Financial Economics, Forthcoming.

Fortin R. & Roth G. (2007). Analyst Coverage of Small Cap Firms in a Period of Brokerage Firm Retrenchment. Journal of Business & Economic Research, 5(12), 61-68.

Han, B. & Kumar, A. (2013). Speculative Retail Trading and Asset Prices. Journal of Financial & Quantitative Analysis. 48(2), 377-404.

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.

Hong H. & Kubick J. D. (2003). Analyzing the Analysts: Career Concerns and Biased Earnings Forecasts. The Journal of Finance, 58(1), 313-351.

Hou, K. & Moskowitz, T. (2005). Market Frictions, Price Delay, and the Cross-Section of Expected Returns. Review of Financial Studies, 18(3), 981-1020.

Imbens G. W. & Wooldridge J. M. (2007). Difference-in-Difference Estimation. NBER Summer 2007 Lecture Notes.

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.

Irvine, P. J. (2003). The Incremental Impact of Analyst Initiation of Coverage. Journal of Corporate Finance, 9, 431–451.

Jensen, M.C. & Meckling W. H. (1976), Theory of the Firm: Managerial Behavior, Ownership Structure, Journal of Financial Economics, 3, 305-360.

Jin, L. & Myers, S. (2006). R2 Around the World: New Theory and New Tests. Journal of Financial Economics, 79(2), 257-292.

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

Kane, M. (2001), Congress to Scrutinize Analysts Again. New York Times, July 30.

Kelley, E. K. & Tetlock P. C. (2017). Retail Short Selling and Stock Prices. Review of Financial Studies, 30(3), 801-834.

Kelly, B. & Ljungqvist, A. (2012). Testing Asymmetric-Information Asset Pricing Models. Review of Financial Studies, 25(5), 1366–1413.

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.

Li, K. (2020). Does Information Asymmetry Impede Market Efficiency? Evidence from Analyst Coverage. Journal of Banking & Finance, 105856.

Liu, Z. & Yezegel, A. (2020). Was MiFID II effective in unbundling execution and research services? Available at SSRN: https://ssrn.com/abstract=3525201.

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.

Mola S., Rau P. R. & Khorana A. (2013). Is There Life after the Complete Loss of Analyst Coverage? The Accounting Review, 88(2), 667-705.

Pastor, L. & Stambaugh R. F. (2003). Liquidity Risk and Expected Stock Returns. The Journal of Political Economy, 111(3), 642-685.

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

Piotroski J. D. & Roulstone D. T. (2004). The Influence of Analysts, Institutional Investors, and Insiders on the Incorporation of Market, Industry, and Firm-Specific Information into Stock Prices, The Accounting Review, 79(4), 1119-1151.

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.

Zhang, X. F. (2006). Information Uncertainty and Stock Returns. The Journal of Finance 61(1), 105-137.

Figure 1 - Top 20 US and EU ETF by asset under management and analyst coverage

The Figure represents graphically the assets under management by the top 20 ETFs in EU and US from 2015 to 2020 together with the average analyst coverage. We identify the 40 ETFs with the 'ETF' function in Bloomberg. Asset under management is expressed in millions of US dollars and analyst coverage is the number of estimates on earning-per-share published by analysts for the stock for each month.

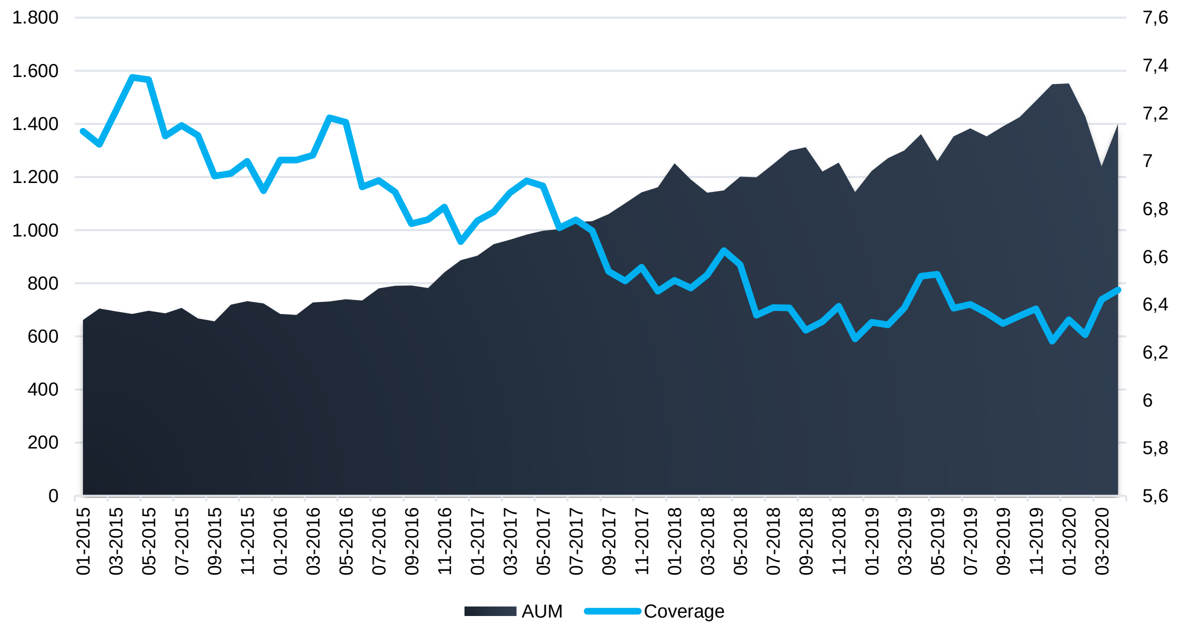
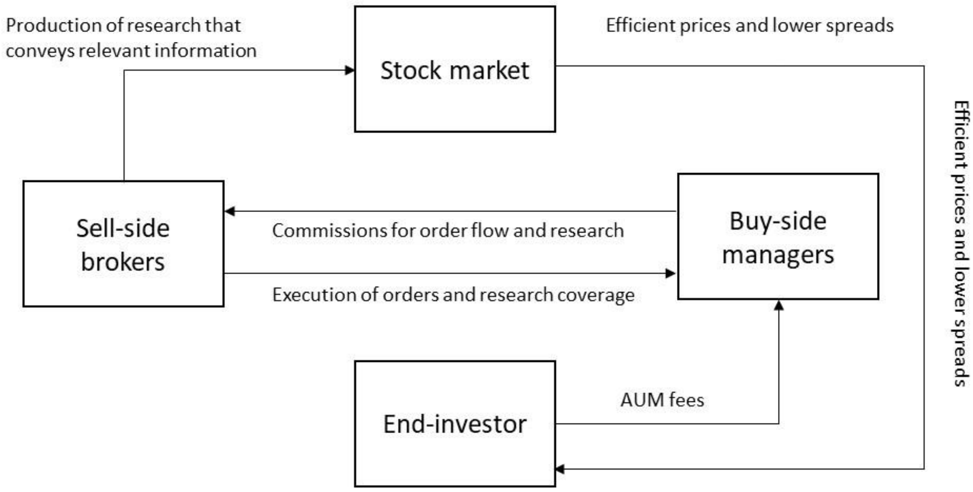
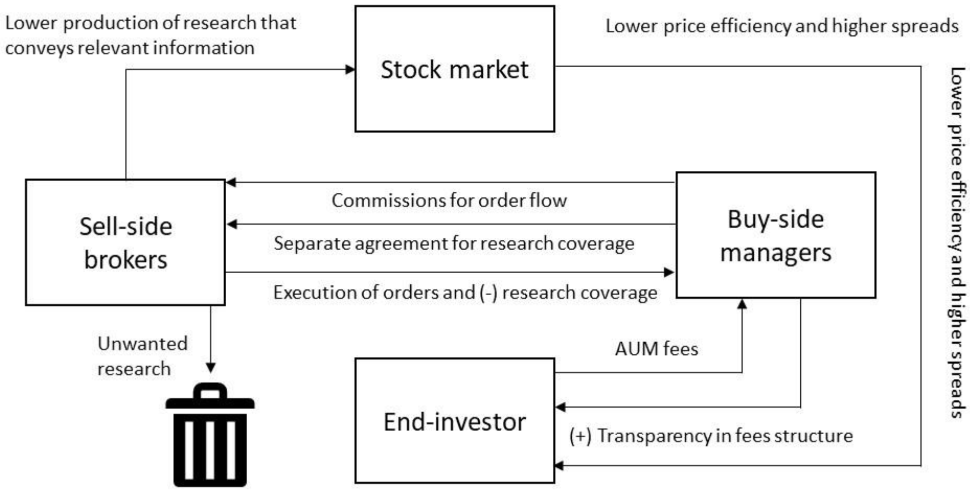


Figure 2 - Pre and post MiFID II framework

(a) Pre-MiFID II (bundling)



(b) Post-MiFID II (scenario A: unbundling with loss of information)



(c) Post-MiFID II (scenario B: unbundling with overproduction)

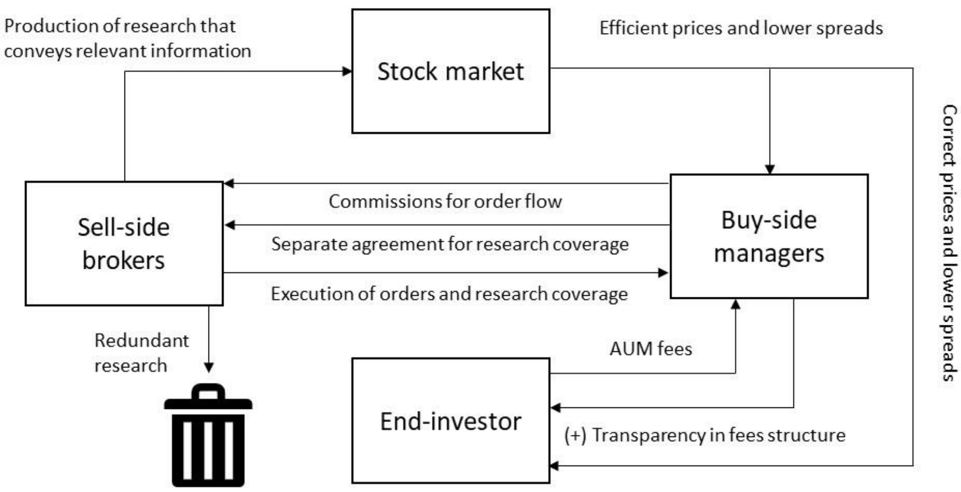


Figure 3 – Example of EPS estimates breakdown by analyst

The Figure shows an example from Thomson Reuters terminal for stock FCA (ticker: FCHA.MI) where the reconciliation between number of EPS estimates and number of analysts is provided (field: ESTD). The breakdown provides names for analysts that provide estimates on the stock. Banks' names and analysts' names are not disclosed for privacy reasons. For the selected example the total number of estimates/analysts is 23, equal to the sum of the estimates included in the mean EPS (17 analysts) (EPS1NE) and total estimates excluded from the mean EPS (6 analysts) (EPS1NET). Once we collected all the reference for banks and analysts following the stock, we verify the actual correspondence with the research provided on the stock for the specific single period.

FCHA.MI | Estimate Details | Single Measure/Single Period	**09-Jan-2020**
Next Earning Report	05-Feb-2020
Measure	Earnings Per Share
Period	FY Dec-19 (This Year)
Basis Indicator	Primary Basis

Earnings Per Share - Consolidated EUR Per Share	
Custom Calculated Mean	2.754
SmartEstimate®	2.854
Mean	2.750
Predicted Surprise %	3.777
Median	2.730
Low	2.242
High	3.230

Analyst Revision Summary	
1 of 17 estimates are new since:	30 Days Ago
Average Revision %:	15.771
Mean change since %:	1.124
Stock price change since 30 days ago %:	-2.677

Earnings Per Share Estimate Details

Estimates included in the Mean (17 Analysts)

	Contributor	Analyst	Earnings Accuracy	Current Estimate	% Difference From Mean	Previous Estimate	Estimate Age	Estimate Date	Review Date	Smart Estimate Weight %
☑	Bank 1	Analyst 1	★★★★★	2.680	-2.545	2.730	161	01-Aug-2019	31-Oct-2019	X-Age
☑	Bank 2	Analyst 2	★★☆☆☆	2.930	6.545	2.800	69	01-Nov-2019	-	3.628
☑	Bank 3	Analyst 3	★★★★☆	3.230	17.455	2.790	20	20-Dec-2019	06-Jan-2020	14.226
☑	Bank 4	Analyst 4	★★★★★	Undisclosed		Undisclosed	66	04-Nov-2019	-	15.677
☑	Bank 5	Analyst 5	★★☆☆☆	2.740	-0.364	2.680	58	12-Nov-2019	-	4.190
☑	Bank 6	Analyst 6	★★★☆☆	2.650	-3.636	2.430	162	31-Jul-2019	18-Dec-2019	X-Age
☑	Bank 7	Analyst 7	★☆☆☆☆	2.540	-7.636	2.640	156	06-Aug-2019	-	X-Age
☑	Bank 8	Analyst 8	Insuf-hist	2.710	-1.455	-	260	24-Apr-2019	18-Dec-2019	X-Age
☑	Bank 9	Analyst 9	★★☆☆☆	2.870	4.364	3.000	66	04-Nov-2019	27-Nov-2019	9.055
☑	Bank 10	Analyst 10	★☆☆☆☆	Undisclosed		Undisclosed	50	20-Nov-2019	-	4.599
☑	Bank 11	Analyst 11	★★★★★	2.710	-1.455	2.800	90	11-Oct-2019	-	12.734
☑	Bank 12	Analyst 12	★★★★☆	2.750	0.000	2.880	175	18-Jul-2019	01-Nov-2019	X-Age
☑	Bank 13	Analyst 13	★★★☆☆	2.730	-0.727	2.750	70	31-Oct-2019	14-Nov-2019	9.463
☑	Bank 14	Analyst 14	★★☆☆☆	2.758	0.291	2.880	66	04-Nov-2019	25-Nov-2019	8.196
☑	Bank 15	Analyst 15	★★★☆☆	2.610	-5.091	2.600	69	01-Nov-2019	19-Dec-2019	10.066
☑	Bank 16	Analyst 16	★★☆☆☆	2.650	-3.636	2.600	69	01-Nov-2019	19-Dec-2019	8.166
☑	Bank 17	Analyst 17	★★★★☆	2.750	0.000	2.720	150	12-Aug-2019	17-Dec-2019	X-Age
	SmartEstimate®			2.854	3.777	-				
	Mean			2.750		-				

Majority is not reflecting sale of Magneti Marelli
DEC19 Earnings on fully reported basis

Estimates excluded from the Mean by Thomson Reuters (6 Analyst(s))

	Contributor	Analyst	Earnings Accuracy	Current Estimate	% Difference From Mean	Previous Estimate	Estimate Age	Estimate Date	Review Date	Smart Estimate Weight %
☐	Bank 1	Analyst 1	★★☆☆☆	Undisclosed		Undisclosed	58	12-Nov-2019	-	-
☐	Bank 2	Analyst 2	★★★★☆	4.090	48.727	2.570	69	01-Nov-2019	-	-
☐	Bank 3	Analyst 3	★★★★★	1.620	-41.091	2.540	69	01-Nov-2019	09-Dec-2019	-
☐	Bank 4	Analyst 4	★★☆☆☆	1.855	-32.545	2.707	65	05-Nov-2019	09-Jan-2020	-
☐	Bank 5	Analyst 5	★★☆☆☆	1.790	-34.909	2.460	59	11-Nov-2019	18-Dec-2019	-
☐	Bank 6	Analyst 6	★★★☆☆	1.970	-28.364	2.610	65	05-Nov-2019	05-Nov-2019	-

Figure 4 – Analyst coverage for the full sample

The Figure shows 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. The sample is based on a data set of 332,701 monthly observations from 9,000 stocks for European countries (Treatment), USA and Japan stocks (Control) from 2015 to 2019.

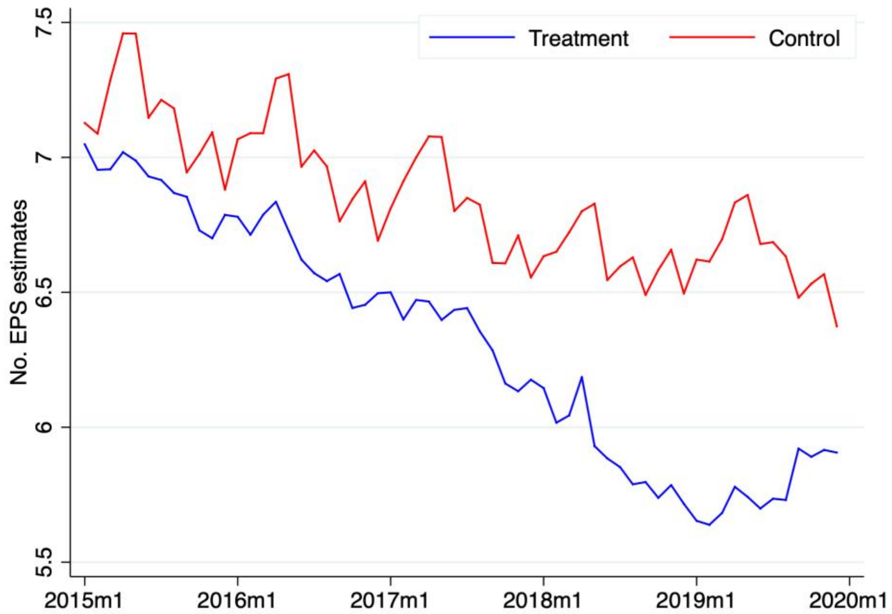


Figure 5 – Bid-ask spread for the full sample

The Figure shows the average bid-ask spread in pps for the entire sample. The sample is based on a data set of 332,701 monthly observations from 9,000 stocks for European countries (Treatment), USA and Japan stocks (Control) from 2015 to 2019.

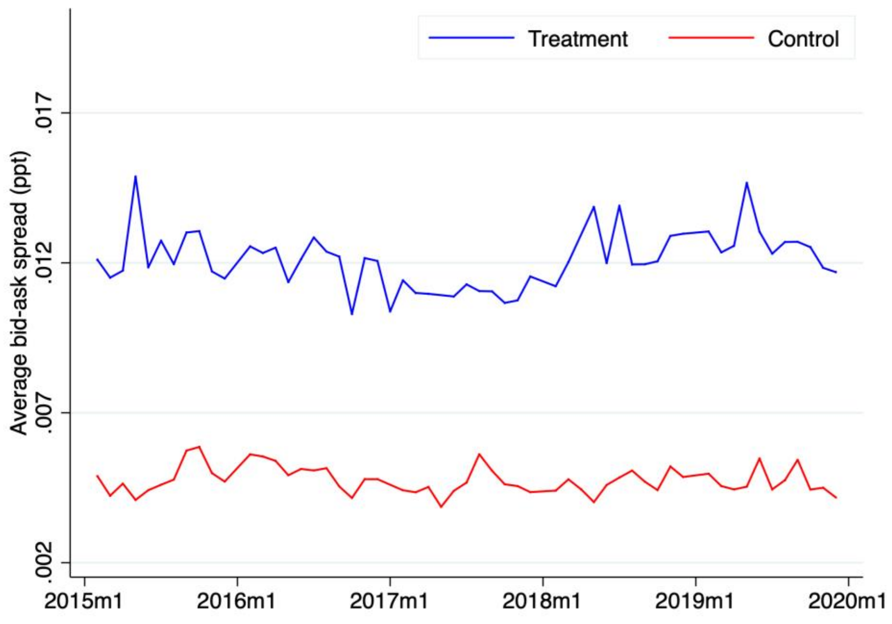


Figure 6 – Three-month daily autocorrelation for the full sample

The Figure shows the last three-month autocorrelation in daily log-returns for the European and International samples. The sample is based on a data set of 2,333,543 daily observations from 2,770 stocks for European countries (Treatment), USA and Japan (Control) from 2016 to 2018. Values are expressed in percentage points, solid dot values represent 1% statistically significant coefficients and empty dot values represent non-statistically significant coefficients.

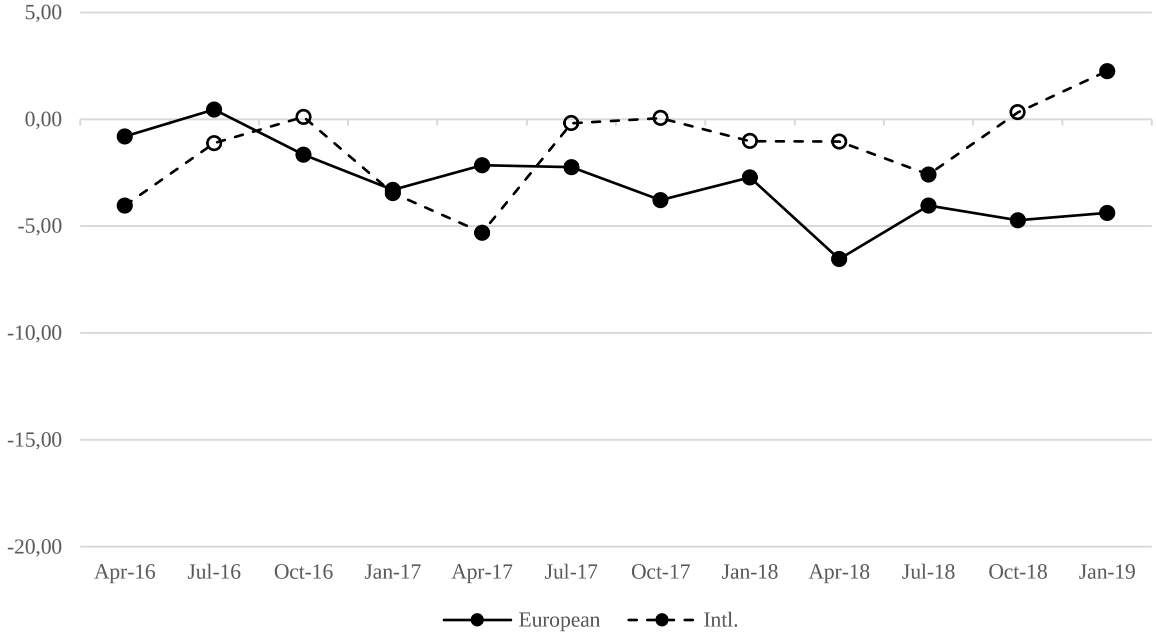


Figure 7 – Three-month daily autocorrelation for the first quintile by market capitalization

The Figure shows the last three-month autocorrelation in daily log-returns for the first quintile by market capitalization for European and International sub-samples. The sample is based on a data set of circa 467,000 daily observations from an original sample of 2,770 stocks for European countries (Treatment), USA and Japan (Control) from 2016 to 2018. Values are expressed in percentage points, solid dot values represent 1% statistically significant coefficients and empty dot values represent non-statistically significant coefficients.

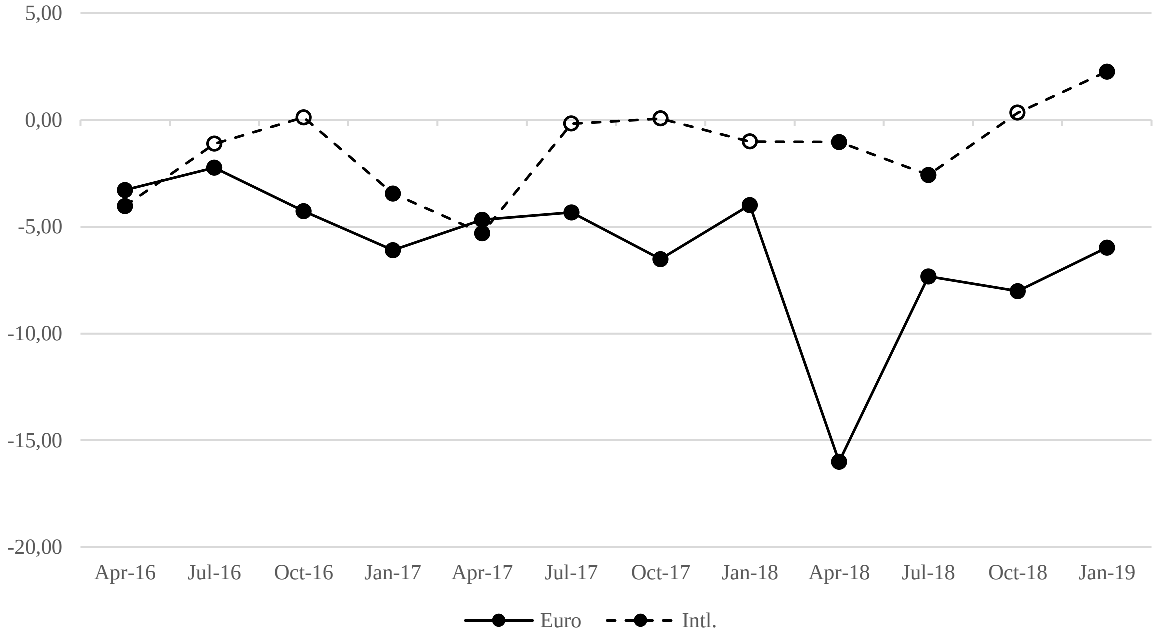
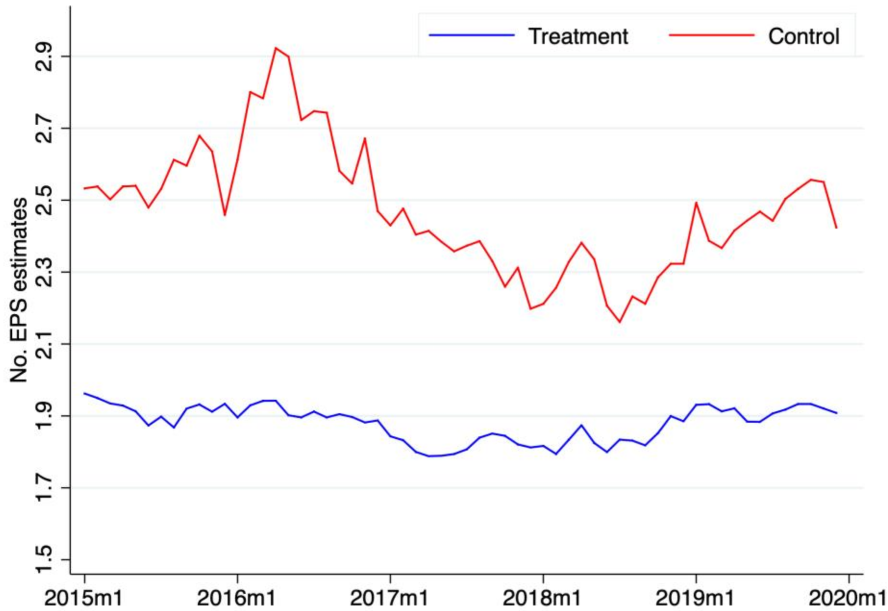


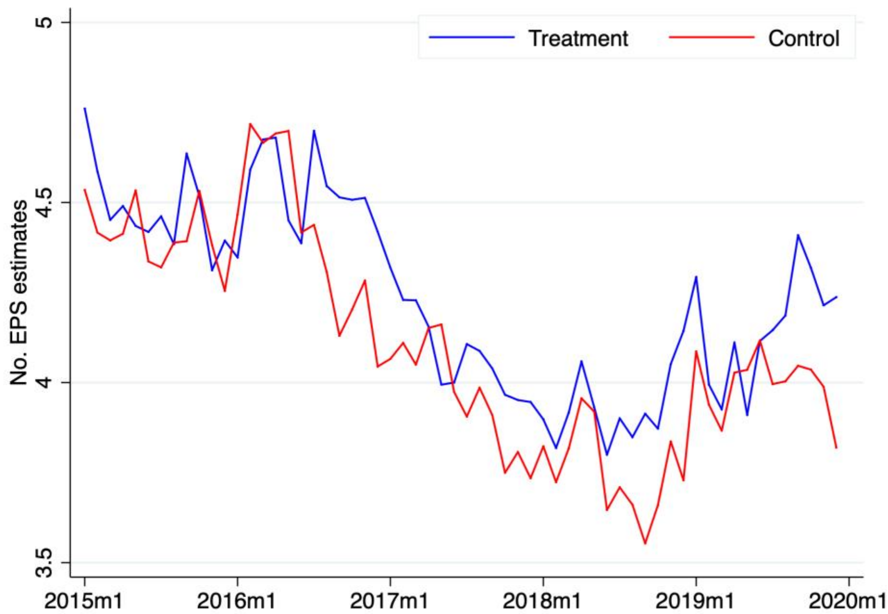
Figure 8 – Analyst coverage partitioned by market cap.

The Figure shows the average analyst coverage by market capitalization. The sample is based on a data set of 332,701 monthly observations from 9,000 stocks for European countries (Treatment), USA and Japan stocks (Control) from 2015 to 2019. Sub-samples are organized by market capitalization: Micro-cap (less than 300 mln euros), Small-cap (between 300 mln and 1 bln euros), Mid-cap (between 1 bln and 3.5 bln euros) and Large-cap (greater than 3.5 bln euros). Analyst coverage is the number of estimates on earning-per-share published by analysts for the stock for each month.

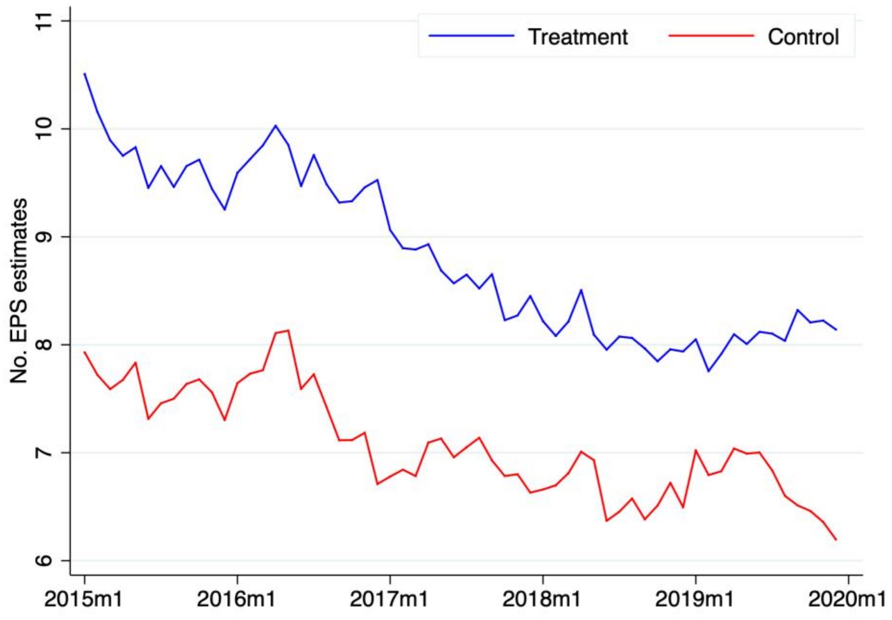
Micro-cap (less than 300 mln euros)



Small cap (between 300 mln and 1 bln euros)



Mid cap (between 1 bln and 3.5 bln euros)



Large cap (greater than 3.5 bln euros)

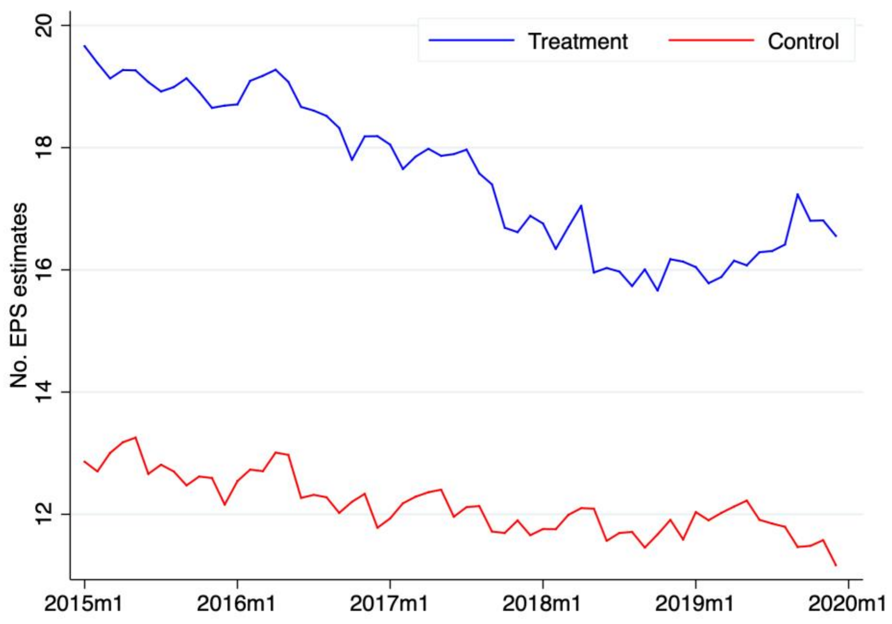
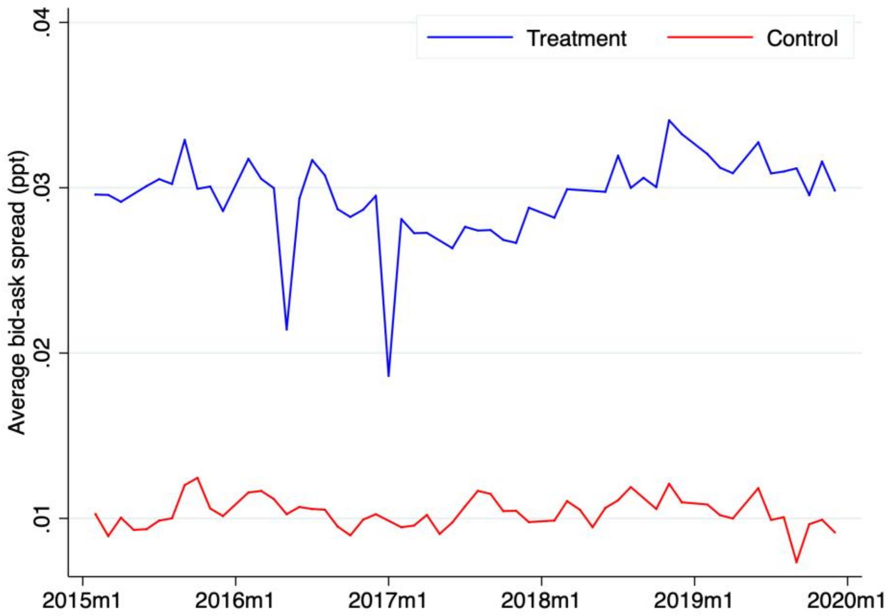


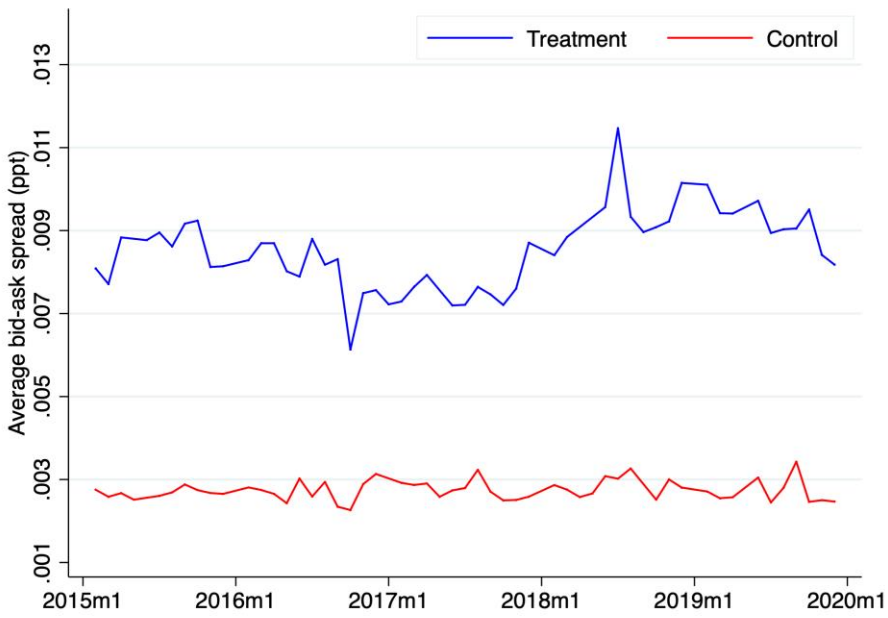
Figure 9 – Bid-Ask Spread partitioned by market cap.

The Figure shows the average bid-ask spread by market capitalization . The sample is based on a data set of circa 333,000 monthly observations from 9,000 stocks for European countries (Treatment), USA, Japan and other non-EU stocks (Control) from 2015 to 2019. Sub-samples are organized by market capitalization: Micro-cap (less than 300 mln euros), Small-cap (between 300 mln and 1 bln euros), Mid-cap (between 1 bln and 3.5 bln euros) and Large-cap (greater than 3.5 bln euros). The Figure represents the average bid-ask spread in pps for the entire sample.

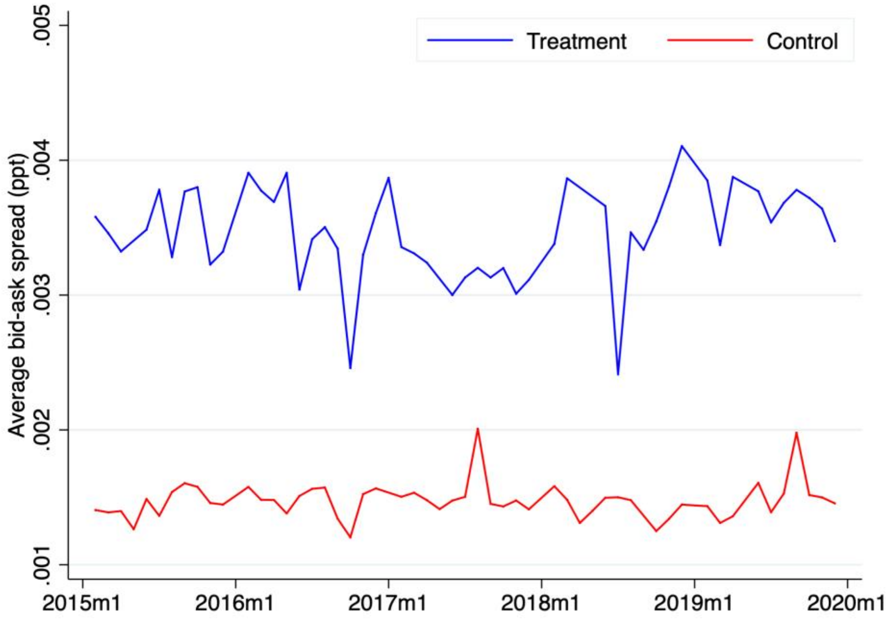
Micro-cap (less than 300 mln euros)



Small cap (between 300 mln and 1 bln euros)



Mid cap (between 1 bln and 3.5 bln euros)



Large cap (greater than 3.5 bln euros)

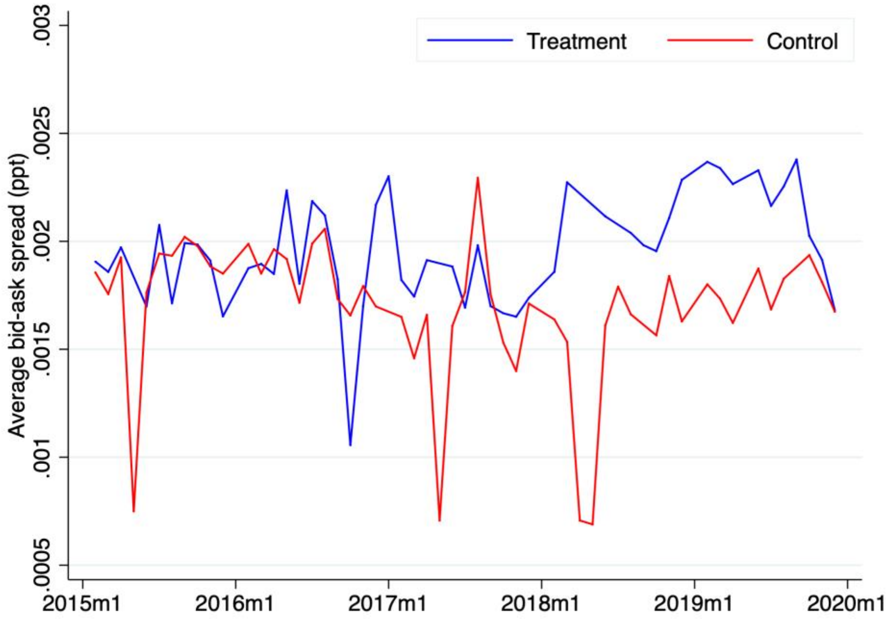


Table 1 – Sample composition by country

The Table presents the sample composition by country. The sample is based on a data set of 332,701 monthly observations from 9,000 stocks for European countries (Treatment), USA and Japan (Control) from 2015 to 2019.

Country	Stocks	N. Obs.	Average n. obs. per stock	Percentage
Austria	46	2,098	46	0.63
Belgium	86	3,721	43	1.12
Denmark	65	2,552	39	0.77
Estonia	13	500	38	0.15
Finland	143	5,592	39	1.68
France	478	19,837	42	5.96
Germany	435	17,861	41	5.37
Greece	39	1,401	36	0.42
Ireland	34	1,318	39	0.40
Italy	255	9,189	36	2.76
Luxembourg	22	827	38	0.25
Netherlands	102	4,217	41	1.27
Portugal	28	1,072	38	0.32
Slovenia	14	424	30	0.13
Spain	116	4,730	41	1.42
Sweden	416	13,082	31	3.93
United Kingdom	60	1,378	23	0.41
European Union (Treatment sample)	2,352	89,799	38	26.99
Japan	1,872	65,767	35	19.77
United States	4,776	177,135	37	53.24
Control sample	6,648	242,902	37	73.01
Full Sample	9,000	332,701	37	100.00

Table 2 – Variable description

The Table presents a complete description for the main variables of study and the covariates we use as control items. The analysis is based on a sample of 332,701 monthly observations from 9,000 stocks for European countries (Treatment), USA and Japan (Control) from 2015 to 2019.

Variable	Description
$analyst_{i,t}$	Monthly number of earnings-per-share estimates provided by analysts and available on I/B/E/S. Based on Lee and So (2017), this variable represents the best proxy for analysts coverage as it captures the updated number of analysts covering a firm (See Figure 3) and reflects the number of estimates concurring in the calculation of I/B/E/S Earnings per Share Total Number of Estimates in the Mean for the current fiscal year (EPS1NE). 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 does not update the estimate in the last 105 days, the 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.
$spread_{i,t}$	Average monthly bid-ask spread for stock *i* in month *t* (see Fong et al. (2017))
$mifid_t$	Dummy variable to identify the treatment, equal to 1 if observation *t* is after January 1, 2018, 0 otherwise
eu_i	Dummy variable to identify the treated sample, equal to 1 if firm *i* is from European Union, 0 otherwise
Market capitalization	Natural logarithm of market capitalization in millions of euros
Turnover	Traded volume expressed in percentage points of market capitalization
$r_{i,m,t}$	Monthly (daily) log-return for market index *m* of stock *i* in month (day) *t*
Volatility	Twelve-month historical volatility for stock *i* from daily observations
Free float	Percentage of free-floating shares on all outstanding shares
Institutional	Percentage of shares held by institutional investors
Short ratio	Ratio between number institutional seller and number of institutional buyer for the stock
$ret_{i,t}$	Daily log-return for stock *i* in day *t*
$delay_{i,t}$	Delay measure equal to $1 - \frac{R^2_{restricted}}{R^2_{unrestricted}}$ as proposed by Hou and Moskowitz (2005) for stock *i* in day *t*

Table 3 – Descriptive statistics for the full sample

The Table presents the descriptive statistics for the main variables of study, where $analyst_{i,t}$ is the number of estimates on earning-per-share published by analysts for the stock for each month and $spread_{i,t}$ represents the average bid-ask spread quoted during that month in bps,. Market capitalization is expressed in millions of euros. The sample is based on a data set of 332,701 monthly observations from 9,000 for European countries (Treatment) and USA and Japan (Control) from 2015 to 2019.

Variable	**N.Obs**	**Mean**	**St.Dev**	**p5**	**p25**	**p50**	**p75**	**p95**	**cv**
				Full sample					
Market cap.	332,701	6,377	23,074	36	243	921	3,658	27,391	3.62
$analyst_{i,t}$	332,701	6.79	6.94	1	2	4	9	22	1.02
$spread_{i,t}$	332,701	45.42	77.81	1.67	6.14	16.62	43.86	204.78	1.71
				European sample (Treatment)					
Market cap.	89,799	3,839	11,554	17	103	438	22,66	18,862	3.01
$analyst_{i,t}$	89,799	6.47	7.34	1	1	3	8	23	1.14
$spread_{i,t}$	89,799	96.07	113.14	4.04	18.20	51.68	126.32	368.10	1.18
				Non-EU sample (Control)					
Market cap.	242,902	7,315	26,012	60	332	1,135	4,182	31,124	3.56
$analyst_{i,t}$	242,902	6.90	6.77	1	2	5	9	21	0.98
$spread_{i,t}$	242,902	27.71	49.87	1.49	4.80	12.53	28.21	105.82	1.80

Table 4 – Pairwise correlations

The Table shows pairwise correlations for the full sample, the treatment sample and the control sample. $analyst_{i,t}$ is the number of analysts that publish an estimate on the earning-per-share of the stock for each month, $spread_{i,t}$ is the bid-ask spread in bps, Market capitalization is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization, Volatility is the historical daily volatility, Free float is the percentage of free floating shares on all outstanding shares, Institutional is the percentage of shares held by institutional investors, Short ratio is the ratio between the number of institutional seller and buyer for the stock and $r_{i,m,t}$ is the local index monthly return. The sample is based on a data set of 332,701 monthly observations from 9,000 stocks from 2015 to 2019.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Full sample				
$analyst_{i,t}$	1.000							
$spread_{i,t}$	-0.287*	1.000						
Market capitalization	0.537*	-0.547*	1.000					
Turnover	-0.008*	0.042*	-0.016*	1.000				
Volatility	-0.154*	0.152*	-0.455*	0.012*	1.000			
Free float	0.126*	-0.230*	0.234*	0.005*	-0.040*	1.000		
Institutional	0.360*	-0.369*	0.397*	0.045*	-0.153*	0.145*	1.000	
Short ratio	0.020*	0.011*	0.028*	0.001	0.002	0.033*	-0.022*	
$r_{i,m,t}$	0.038*	-0.050*	0.023*	-0.001	-0.006*	0.014*	0.007*	-0.013*
				European sample (Treatment)				
$analyst_{i,t}$	1.000							
$spread_{i,t}$	-0.298*	1.000						
Market capitalization	0.548*	-0.586*	1.000					
Turnover	-0.019*	0.015*	-0.032*	1.000				
Volatility	-0.183*	0.229*	-0.455*	0.044*	1.000			
Free float	0.052*	-0.110*	0.068*	0.021*	0.057*	1.000		
Institutional	0.227*	-0.300*	0.425*	0.094*	-0.190*	-0.017*	1.000	
Short ratio	0.003	-0.013*	0.032*	0.010*	-0.010*	-0.010*	0.051*	
$r_{i,m,t}$	0.033*	-0.033*	0.011*	-0.003	-0.016*	0.004	-0.009*	-0.019*
				Non-EU sample (Control)				
$analyst_{i,t}$	1.000							
$spread_{i,t}$	-0.278*	1.000						
Market capitalization	0.519*	-0.521*	1.000					
Turnover	-0.001	0.009*	-0.003	1.000				
Volatility	-0.161*	0.231*	-0.503*	0.003	1.000			
Free float	0.128*	-0.144*	0.261*	0.006*	-0.133*	1.000		
Institutional	0.411*	-0.354*	0.364*	0.029*	-0.177*	0.107*	1.000	
Short ratio	0.029*	0.045*	0.024*	-0.002	0.002	0.044*	-0.014*	
$r_{i,m,t}$	0.036*	-0.047*	0.021*	0.001	-0.006*	0.005*	0.007*	-0.011*

* shows significance at the 1% level

Table 5 – Descriptive statistics partitioned by market cap sub-samples

The Table shows descriptive statistics for the two variables of study for the different market capitalization sub-samples. $analyst_{i,t}$ is the number of estimates on earning-per-share published by analysts for the stock for each month, $spread_{i,t}$ represent the average bid-ask spread quoted during that month in bps. The data set is organized into four different sub-samples according to specific market capitalization thresholds: Micro-cap (with market capitalization less than 300 mln euros), Small-cap (between 300 mln and 1 bln euros), Mid-cap (between 1 bln and 3.5 bln euros) and Large-cap (greater than 3.5 bln euros). The sample is based on a data set of circa 332,701 monthly observations from 9,000 stocks from 2015 to 2019.

Variable	Sub-sample	N. Obs	Mean	St. Dev.	p5	p25	p50	p75	p95
				Full sample					
$analyst_{i,t}$	Micro-cap	95,256	2.19	1.74	1	1	2	3	6
	Small-cap	76,322	4.02	2.91	1	2	3	5	9
	Mid-cap	75,571	7.37	5.01	1	4	6	10	17
	Large-cap	85,552	13.28	8.72	1	6	13	19	29
$spread_{i,t}$	Micro-cap	95,256	108.87	113.65	11.12	29.54	64.69	144.93	414.36
	Small-cap	76,322	36.66	51.57	4.61	11.04	20.35	39.29	154.69
	Mid-cap	75,571	18.84	29.29	2.09	5.10	10.28	20.98	63.07
	Large-cap	85,552	16.06	39.16	1.03	2.33	5.17	13.56	38.76
				European sample (Treatment)					
$analyst_{i,t}$	Micro-cap	38,978	1.84	1.29	1	1	1	2	4
	Small-cap	17,782	3.90	2.79	1	2	3	5	9
	Mid-cap	15,756	8.47	4.99	2	5	7	11	19
	Large-cap	17,283	17.78	7.71	4	12	18	23	30
$spread_{i,t}$	Micro-cap	38,978	161.79	131.67	18.89	60.06	119.05	229.89	459.91
	Small-cap	17,782	80.74	81.68	10.22	29.35	54.53	100.92	237.59
	Mid-cap	15,756	39.96	47.48	4.08	11.25	23.09	50.25	136.33
	Large-cap	17,283	22.28	35.32	2.11	5.35	10.66	26.24	75.47
				Non-EU sample (Control)					
$analyst_{i,t}$	Micro-cap	56,278	2.42	1.95	1	1	2	3	6
	Small-cap	58,540	4.06	2.94	1	2	3	5	9
	Mid-cap	59,815	7.09	4.98	1	4	6	9	17
	Large-cap	68,269	12.26	8.61	1	5	11	18	28
$spread_{i,t}$	Micro-cap	56,278	74.81	84.30	9.96	22.83	43.20	89.91	263.03
	Small-cap	58,540	24.67	29.92	4.35	9.71	16.63	29.20	66.93
	Mid-cap	59,815	13.82	19.87	1.98	4.52	8.55	16.72	38.28
	Large-cap	68,269	14.64	39.85	0.96	2.08	4.17	11.30	46.95

Table 6 – Analyst coverage diff-in-diff models for the full sample

The Table presents the estimates of the model described in Equation 1 where the dependent variable is $analyst_{i,t}$ .. The sample is based on a data set of 332,701 monthly observations from 9,000 stocks for European countries (Treatment), USA and Japan (Control) from 2015 to 2019. $analyst_{i,t}$ is the number of analysts that publish an estimate on the earning-per-share of the stock for each month, $mifid_t$ is a dummy variable equal to one for observations after 1st January 2018 and zero otherwise, eu_i is a dummy variable equal to one for EU stocks subjected to MiFID II provisions and zero otherwise, Market capitalization. is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization, Volatility is the historical daily volatility, Free float is the percentage of free floating shares on all outstanding shares, Institutional is the percentage of shares held by institutional investors, Short ratio is the ratio between the number of institutional seller and buyer for the stock and $r_{i,m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

Variable	(M1) $analyst_{i,t}$	(M2) $analyst_{i,t}$	(M3) $analyst_{i,t}$
$mifid_t$	0.089***	0.090***	0.094***
	(3.206)	(3.244)	(3.378)
eu_i	1.468***		
	(9.336)		
$mifid_t * eu_i$	-0.575***	-0.577***	-0.591***
	(-9.377)	(-9.402)	(-9.622)
Market capitalization	1.069***	1.064***	0.915***
	(27.909)	(27.779)	(21.585)
Turnover	0.022	0.023	0.019
	(1.473)	(1.518)	(1.349)
Volatility	0.198	0.167	0.084
	(0.975)	(0.825)	(0.400)
Free float	0.016***	0.016***	0.015***
	(7.676)	(7.619)	(7.229)
Institutional	0.014***	0.013***	0.012***
	(10.503)	(10.157)	(8.863)
Short ratio	0.008	0.007	0.000
	(0.788)	(0.752)	(0.027)
$r_{i,m,t}$	-0.572***	-0.572***	-0.516***
	(-9.698)	(-9.703)	(-8.730)
Constant	-3.057***	-2.395***	-0.875**
	(-9.876)	(-7.445)	(-2.500)
Obs.	332,701	332,701	332,701
R-squared	47.9%	45.2%	43.3%
Year-Month FE	YES	YES	YES
Country-Firm FE	NO	Country	Firm

T-values are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 7 – Analyst coverage diff-in-diff models for market cap sub-samples

The Table presents the estimates of the model described in Equation 1 where the dependent variable is $analyst_{i,t}$. The sample is based on a data set of circa 332,701 monthly observations from 9,000 stocks for European countries (Treatment), USA and Japan (Control) from 2015 to 2019. Sub-samples are organized by market capitalization: Micro-cap (less than 300 mln euros), Small-cap (between 300 mln and 1 bln euros), Mid-cap (between 1 bln and 3.5 bln euros) and Large-cap (greater than 3.5 bln euros). $analyst_{i,t}$ is the number of analysts that publish an estimate on the earning-per-share of the stock for each month, $mifid_t$ is a dummy variable equal to one for observations after 1st January 2018 and zero otherwise, eu_i is a dummy variable equal to one for EU stocks subjected to MiFID II provisions and zero otherwise, Market capitalization is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization, Volatility is the historical daily volatility, Free float is the percentage of free floating shares on all outstanding shares, Institutional is the percentage of shares held by institutional investors, Short ratio is the ratio between the number of institutional seller and buyer for the stock and $r_{i,m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

	(M4)	(M5)	(M6)	(M7)
Variable	Micro-cap	Small-cap	Mid-cap	Large-cap
$mifid_t$	0.028	0.038	-0.041	0.208***
	(0.848)	(1.000)	(-0.691)	(2.958)
eu_i	-0.129*	0.388***	2.428***	5.482***
	(-1.933)	(2.623)	(8.615)	(13.442)
$mifid_t * eu_i$	0.100*	-0.132	-0.608***	-1.614***
	(1.737)	(-1.609)	(-4.890)	(-10.413)
Market capitalization	0.476***	0.912***	1.084***	1.304***
	(13.016)	(13.237)	(9.554)	(9.623)
Turnover	0.025**	0.010	0.070	0.278**
	(2.022)	(0.219)	(1.115)	(2.452)
Volatility	-0.148	0.242	0.950*	0.957
	(-1.064)	(0.772)	(1.709)	(0.905)
Free float	0.005***	0.012***	0.020***	0.016***
	(3.895)	(5.167)	(4.143)	(2.695)
Institutional	0.015***	0.014***	0.017***	0.017***
	(9.500)	(10.501)	(6.815)	(4.750)
Short ratio	-0.014*	0.003	-0.036	-0.016
	(-1.780)	(0.164)	(-0.729)	(-0.361)
$r_{i,m,t}$	-0.230***	-0.489***	-0.606***	-0.838***
	(-3.890)	(-5.342)	(-4.465)	(-5.106)
Constant	-0.687***	-3.241***	-4.047***	-2.466*
	(-3.169)	(-6.802)	(-4.318)	(-1.769)
Obs.	95,256	76,322	75,571	85,552
R-squared	13.9%	14.5%	13.4%	25.7%
Year-Month FE	YES	YES	YES	YES
Country-Firm FE	NO	NO	NO	NO

T-values are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 8 – Liquidity diff-in-diff models for the full sample

The Table presents the estimates of the model described in Equation 2 where the dependent variable is $spread_{i,t}$ in bps. The sample is based on a data set of 332,701 monthly observations from 9,000 stocks for European countries (Treatment), USA and Japan (Control) from 2015 to 2019. $spread_{i,t}$ is the bid-ask spread in bps, $mifid_t$ is a dummy variable equal to one for observations after 1st January 2018 and zero otherwise, eu_i is a dummy variable equal to one for EU stocks subjected to MiFID II provisions and zero otherwise, Market capitalization is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization, Volatility is the historical daily volatility, Free float is the percentage of free floating shares on all outstanding shares, Institutional is the percentage of shares held by institutional investors, Short ratio is the ratio between the number of institutional seller and buyer for the stock and $r_{i,m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

Variable	(M8) $spread_{i,t}$	(M9) $spread_{i,t}$	(M10) $spread_{i,t}$
$mifid_t$	3.447*** (6.882)	2.392*** (5.853)	3.613*** (6.873)
eu_i	45.958*** (24.148)		
$mifid_t * eu_i$	8.522*** (6.143)	8.470*** (6.106)	8.554*** (6.139)
Market capitalization	-22.718*** (-42.280)	-22.574*** (-44.754)	-24.894*** (-31.537)
Turnover	-2.820*** (-3.705)	-2.936*** (-3.650)	-2.931*** (-3.745)
Volatility	-6.321 (-1.472)	-7.229* (-1.750)	-7.954 (-1.471)
Free float	-0.068** (-2.545)	-0.071*** (-2.722)	-0.067** (-2.253)
Institutional	-0.104*** (-6.981)	-0.126*** (-8.238)	-0.079*** (-4.542)
Short ratio	2.221*** (5.462)	2.215*** (5.464)	2.171*** (5.335)
$r_{i,m,t}$	-30.144*** (-14.239)	-30.392*** (-14.365)	-29.381*** (-13.839)
Constant	198.683*** (39.756)	204.574*** (40.543)	221.239*** (33.229)
Obs.	332,701	332,701	332,701
R-squared	32.2%	39.7%	25.6%
Year-Month FE	YES	YES	YES
Country-Firm FE	NO	Country	Firm

T-values are in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

Table 9 – Liquidity diff-in-diff models for market cap sub-samples

The Table presents the estimates of the model described in Equation 2 where the dependent variable is $spread_{i,t}$ in bps. The original sample is based on a data set of circa 332,701 monthly observations from 9,000 stocks for European countries (Treatment), USA and Japan (Control) from 2015 to 2019. We organize sub-samples by market capitalization: Micro-cap (less than 300 mln euros), Small-cap (between 300 mln and 1 bln euros), Mid-cap (between 1 bln and 3.5 bln euros) and Large-cap (greater than 3.5 bln euros). $spread_{i,t}$ is the bid-ask spread in bps, $mifid_t$ is a dummy variable equal to one for observations after 1st January 2018 and zero otherwise, eu_i is a dummy variable equal to one for EU stocks subjected to MiFID II provisions and zero otherwise, Market capitalization is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization, Volatility is the historical daily volatility, Free float is the percentage of free floating shares on all outstanding shares, Institutional is the percentage of shares held by institutional investors, Short ratio is the ratio between the number of institutional seller and buyer for the stock and $r_{i,m,t}$ is the local index monthly return. In order to provide robust results, we discard the top 95th percentile of variable $spread_{i,t}$ from each sub-sample, the resulting sample is based on 278,135 monthly observation. Standard errors are clustered by firm according to Petersen (2009).

Variable	(M11) Micro-cap	(M12) Small-cap	(M13) Mid-cap	(M14) Large-cap
$mifid_t$	-0.884	-1.962***	0.328	0.759***
	(-0.589)	(-4.196)	(1.389)	(7.012)
eu_i	51.048***	32.402***	10.819***	5.990***
	(18.305)	(27.208)	(17.420)	(13.796)
$mifid_t * eu_i$	3.194	1.206	0.062	-0.065
	(1.440)	(1.106)	(0.129)	(-0.301)
Market capitalization	-44.432***	-12.284***	-4.907***	-1.836***
	(-35.157)	(-20.302)	(-16.321)	(-14.173)
Turnover	-2.148***	-3.249***	-1.953***	-0.534**
	(-3.110)	(-5.597)	(-5.321)	(-2.373)
Volatility	-5.116	-3.968***	0.423	0.910
	(-0.952)	(-2.738)	(0.514)	(1.027)
Free float	-0.175***	-0.107***	-0.023***	-0.016***
	(-3.842)	(-7.282)	(-2.843)	(-3.306)
Institutional	-0.135***	-0.064***	-0.058***	-0.028***
	(-4.208)	(-6.699)	(-12.681)	(-9.111)
Short ratio	1.375***	1.083***	0.448**	0.136
	(2.848)	(3.303)	(2.081)	(0.987)
$r_{i,m,t}$	-78.254***	-12.639***	-3.750***	-3.828***
	(-11.757)	(-5.924)	(-4.040)	(-7.556)
Constant	304.861***	110.808***	54.336***	29.234***
	(35.593)	(25.198)	(21.846)	(21.022)
Obs.	75,056	65,314	63,631	74,134
R-squared	24.5%	30.8%	21.5%	18.9%
Year-Month FE	YES	YES	YES	YES
Country-Firm FE	NO	NO	NO	NO

T-values are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 10 – Price efficiency triple interaction models for full sample

The Table presents results for model described in Equation 3. The dependent variable is $ret_{i,t}$ and represents the log-return for stock *i* in time *t*. The sample is based on 2,333,543 daily observations from 2,770 stock for European countries (Treatment), US and Japan (Control) from 2016 to 2019. Market capitalization is the natural logarithm of daily market capitalization, Turnover is the traded volume expressed in percentage points of market capitalization, Volatility is historical daily volatility and $r_{i,m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

	(M15) $ret_{i,t}$	(M16) $ret_{i,t}$	(M17) $ret_{i,t}$
$ret_{i,t-1}$	-.001 (-.606)	-.001 (-.607)	-.002 (-.909)
$mifid_t$	-.043*** (-8.503)	-.043*** (-8.503)	-.077*** (-12.153)
eu_i	.023*** (4.214)		
$mifid_t * eu_i$	-.007 (-1.196)	-.007 (-1.14)	.016** (2.371)
$mifid_t * ret_{i,t-1}$	.006** (2.154)	.006** (2.154)	.005* (1.716)
$eu_i * ret_{i,t-1}$	.001 (.57)	.001 (.543)	0 (-.042)
$mifid_t * eu_i * ret_{i,t-1}$	-.006* (-1.695)	-.006* (-1.689)	-.006* (-1.766)
Market capitalization	.025*** (17.908)	.025*** (17.592)	.26*** (23.659)
Turnover	3.415*** (3.099)	3.464*** (3.091)	5.856*** (3.52)
Volatility	-.007** (-2.316)	-.007** (-2.533)	.025*** (8.276)
$r_{i,m,t}$	66.065*** (91.747)	66.068*** (91.769)	65.97*** (91.823)
Constant	-.13*** (-12.063)	-.096*** (-2.831)	-1.663*** (-23.789)
Obs.	2,333,543	2,333,543	2,333,543
R-squared	10.40%	10.43%	10.51%
Std. Errors	Firm-clustered	Firm-clustered	Firm-clustered
Year-Month FE	YES	YES	YES
Country-Firm FE	NO	Country	Firm

T-values are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 11 – Price efficiency triple interaction models for market cap sub-samples

The Table presents the estimates for the model described in Equation 3. The dependent variable is $ret_{i,t}$ and represents the log-return for stock i in time t. The sample is based on 2,333,543 daily observations from 2,770 stock for European countries (Treatment), US and Japan (Control) from 2016 to 2019. Sub-samples are organized by market capitalization: Micro-cap (less than 300 mln euros), Small-cap (between 300 mln and 1 bln euros), Mid-cap (between 1 bln and 3.5 bln euros) and Large-cap (greater than 3.5 bln euros). Market capitalization is the natural logarithm of daily market capitalization, Turnover is the traded volume expressed in percentage points of market capitalization Volatility is historical daily volatility and $r_{i,m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

	(M18)	(M19)	(M20)	(M21)
Variable	Micro-cap	Small-cap	Mid-cap	Large-cap
$ret_{i,t-1}$	-.002	0	-.003	0
	(-.434)	(-.125)	(-1.064)	(-.012)
$mifid_t$	-.029	-.067***	-.049***	-.033***
	(-1.464)	(-5.39)	(-5.458)	(-4.232)
eu_i	.214***	.095***	.032***	-.008
	(8.353)	(6.482)	(3.028)	(-.944)
$mifid_t * eu_i$	-.027	.011	-.004	.014*
	(-1.332)	(.86)	(-.371)	(1.646)
$mifid_t * ret_{i,t-1}$	.012	.006	0	.005
	(1.346)	(1.356)	(.06)	(1.04)
$eu_i * ret_{i,t-1}$	.001	-.006	.006	-.002
	(.125)	(-1.359)	(1.433)	(-.516)
$mifid_t * eu_i * ret_{i,t-1}$	-.013	-.003	-.006	-.004
	(-1.339)	(-.541)	(-1.043)	(-.716)
Market capitalization	.161***	.216***	.155***	.037***
	(15.175)	(15.242)	(13.766)	(8.638)
Turnover	6.561**	7.86***	2.817**	.764
	(2.145)	(5.114)	(2.54)	(.549)
Volatility	.021***	.024***	.021***	.014***
	(4.433)	(4.832)	(4.27)	(2.669)
$r_{i,m,t}$	38.541***	69.993***	83.274***	88.854***
	(45.877)	(55.187)	(71.874)	(75.555)
Constant	-.911***	-1.436***	-1.164***	-.299***
	(-15.863)	(-15.594)	(-13.443)	(-7.095)
Obs.	874,195	512,746	495,507	442,811
R-squared	2.69%	11.74%	20.60%	28.31%
Std. Errors	Firm-clustered	Firm-clustered	Firm-clustered	Firm-clustered
Year-Month FE	YES	YES	YES	YES
Country-Firm FE	NO	NO	NO	NO

T-values are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 12 - Price efficiency diff-in-diff with delay measure

The Table presents the estimates for the model described in Equation 4. The dependent variable is $delay_{i,t}^{w}$ and represents the delay measure as presented by Hou and Moskowitz (2005), with $delay_{i,t}^{w} = 1 - \frac{R^2_{restricted,w}}{R^2_{unrestricted,w}}$ with w being the number of business days for the pair time-series regressions on restricted and unrestricted market model for stock i. The sample is based on 2,333,543 daily observations from 2,770 stock for European countries (Treatment), US and Japan (Control) from 2016 to 2019. Sub-samples are organized by market capitalization: Micro-cap (less than 300 mln euros), Small-cap (between 300 mln and 1 bln euros), Mid-cap (between 1 bln and 3.5 bln euros) and Large-cap (greater than 3.5 bln euros). All model presents year-month fixed effects and as control variables: Market capitalization, Turnover, Volatility and $r_{i,m,t}$. Standard errors are clustered by firm according to Petersen (2009).

Estimation window	**Variable**	(M22) Full sample	(M23) Micro-cap	(M24) Small-cap	(M25) Mid-cap	(M26) Large-cap
$delay_{i,t}^{60}$	$mifid_t$	.042***	.025*	.016*	.047***	.06***
		-8.809	-1.722	-1.687	-5.706	-6.24
	eu_i	.198***	.216***	.233***	.169***	.071***
		-25.37	-13.301	-19.71	-14.993	-5.846
	$mifid_t * eu_i$	-.01**	0.005	0.006	-.041***	0.005
		(-1.963)	-0.35	-0.631	(-4.116)	-0.501
	Obs.	1,940,413	688,129	437,535	428,403	386,333
	R-squared	29.9%	7.5%	17.9%	12.4%	7.6%
$delay_{i,t}^{120}$	$mifid_t$	.038***	.032*	.029***	.039***	.039***
		-7.914	-1.666	-2.907	-5.215	-4.555
	eu_i	.2***	.237***	.25***	.16***	.068***
		-23.455	-14.381	-20.926	-14.988	-6.149
	$mfid_t * eu_i$	-.015***	0.003	-0.02	-.041***	0.009
		(-2.649)	-0.137	(-1.592)	(-3.865)	-0.865
	Obs.	1,793,007	638,549	404,242	395,405	354,798
	R-squared	38.5%	12.1%	0.22.9%	14.7%	6.9%
$delay_{i,t}^{240}$	$mifid_t$	.016***	-0.015	.023***	.011*	.013*
		-3.162	(-.546)	-2.629	-1.707	-1.856
	eu_i	.193***	.229***	.247***	.134***	.058***
		-20.283	-12.89	-20.106	-13.446	-6.23
	$mifid_t * eu_i$	-.022***	0.027	-.051***	-.04***	-0.001
		(-3.245)	-0.965	(-3.552)	(-3.58)	(-.072)
	Obs.	1,495,497	534,899	336,961	330,313	293,313
	R-squared	41.8%	15.9%	23.8%	16.0%	5.7%

T-values are in parentheses
*** p<.01, ** p<.05, * p<.1

Table 13 – Robustness' check on analyst coverage by sample composition

The Table presents the estimates of the model described in Equation 1 where the dependent variable is $analyst_{i,t}$. The original sample is reduced by alternatively excluding stocks from US and Japan from the Control sample. The Table shows the results for full sample and, for the sake of simplicity, large cap sub-sample only. Results for the remaining market cap sub-samples are available from the authors upon request. $analyst_{i,t}$ is the number of analysts that publish an estimate on the earning-per-share of the stock for each month, $mifid_t$ is a dummy variable equal to one for observations after 1st January 2018 and zero otherwise, eu_i is a dummy variable equal to one for EU stocks and zero otherwise, Market capitalization is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization, Volatility is the historical daily volatility, Free float is the percentage of free floating shares on all outstanding shares, Institutional is the percentage of shares held by institutional investors, Short ratio is the ratio between the number of institutional seller and buyer for the stock and $r_{m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

	(M27) $analyst_{i,t}$	(M28) $analyst_{i,t}$	(M29) $analyst_{i,t}$	(M30) $analyst_{i,t}$
$mifid_t$	0.273*** (5.922)	0.101*** (2.897)	0.342** (2.523)	0.255*** (3.059)
eu_i	3.061*** (18.964)	0.855*** (4.906)	5.791*** (13.290)	5.504*** (12.670)
$mifid_t * eu_i$	-0.467*** (-6.951)	-0.626*** (-9.555)	-0.988*** (-5.509)	-1.805*** (-11.290)
Market capitalization	1.295*** (22.774)	1.016*** (23.945)	2.113*** (8.289)	1.176*** (7.893)
Turnover	-0.001 (-0.100)	0.022 (1.435)	0.132 (1.475)	0.192* (1.945)
Volatility	0.753** (1.984)	0.029 (0.133)	1.080 (0.696)	0.385 (0.321)
Free float	0.021*** (6.230)	0.015*** (6.792)	0.035*** (3.449)	0.015** (2.439)
Institutional	0.003 (1.319)	0.015*** (10.242)	0.002 (0.395)	0.020*** (5.012)
Short ratio	-0.022* (-1.930)	0.006 (0.498)	-0.256 (-1.585)	-0.039 (-0.858)
$r_{m,t}$	-0.713*** (-8.531)	-0.705*** (-9.949)	-1.586*** (-5.972)	-1.239*** (-6.530)
Constant	-5.618*** (-12.973)	-2.137*** (-6.051)	-9.608*** (-3.897)	-1.445 (-0.930)
Obs.	155,566	266,934	31,524	71,311
R-squared	62.1%	44.7%	45.2%	25.5%
Year-Month FE	YES	YES	YES	YES
Country-Firm FE	NO	NO	NO	NO
Sample	Full sample (Ex US)	Full sample (Ex Japan)	Large-cap (Ex US)	Large-cap (Ex Japan)

T-values are in parentheses
*** p<.01, ** p<.05, * p<.1

Table 14 – Robustness' check on liquidity by sample composition

The Table presents the estimates of the model described in Equation 1b where the dependent variable is $spread_{i,t}$ The original sample is reduced by alternatively excluding stocks from USA and Japan from the Control sample. The Table shows the results for full sample and, for the sake of simplicity, large cap sub-sample only. Results for the remaining market cap sub-samples are available from the authors upon request. $spread_{i,t}$ is the bid-ask spread in bps, $mifid_t$ is a dummy variable equal to one for observations after 1st January 2018 and zero otherwise, eu_i is a dummy variable equal to one for EU stocks and zero otherwise, Market capitalization is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization, Volatility is the historical daily volatility, Free float is the percentage of free floating shares on all outstanding shares Institutional is the percentage of shares held by institutional investors, Short ratio is the ratio between the number of institutional seller and buyer for the stock and $r_{i,m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

Variable	(M31) $spread_{i,t}$	(M32) $spread_{i,t}$	(M33) $spread_{i,t}$	(M34) $spread_{i,t}$
$mifid_t$	1.297*	3.249***	1.817***	0.330***
	(1.743)	(6.281)	(6.242)	(3.402)
eu_i	53.921***	38.139***	-3.199***	8.613***
	(27.021)	(18.500)	(-6.144)	(20.220)
$mifid_t * eu_i$	10.144***	7.688***	-0.420	0.089
	(7.295)	(5.455)	(-1.489)	(0.419)
Market capitalization	-23.961***	-25.168***	-1.630***	-1.728***
	(-28.065)	(-41.398)	(-6.111)	(-13.666)
Turnover	-1.642***	-2.964***	-0.200	-0.423**
	(-2.988)	(-3.449)	(-1.399)	(-2.241)
Volatility	-6.238	-11.233**	0.556	1.003
	(-0.994)	(-2.282)	(0.354)	(1.162)
Free float	-0.136***	-0.073**	-0.040***	-0.009*
	(-3.048)	(-2.485)	(-4.084)	(-1.901)
Institutional	0.023	-0.136***	-0.000	-0.019***
	(0.786)	(-7.900)	(-0.016)	(-5.831)
Short ratio	0.451	2.512***	0.257	0.110
	(0.956)	(4.964)	(0.652)	(0.782)
$r_{m,t}$	-41.472***	-34.938***	-4.460***	-2.965***
	(-13.245)	(-11.956)	(-4.518)	(-5.630)
Constant	204.470***	224.530***	36.870***	24.265***
	(28.267)	(37.819)	(14.528)	(17.524)
Obs.	155,566	266,934	30,395	68,936
R-squared	30.5%	34.2%	12.9%	27.6%
Year-Month FE	YES	YES	YES	YES
Country-Firm FE	NO	NO	NO	NO
Sample	Full sample (Ex US)	Full sample (Ex Japan)	Large-cap (Ex US)	Large-cap (Ex Japan)

T-values are in parentheses
*** p<.01, ** p<.05, * p<.1

Table 15 – Robustness' check with PSM for analyst coverage and stock liquidity

The Table presents robustness check analysis on models from Equation 1 and Equation 2 when Propensity Score Matching (PSM) is applied. The original sample is based on 332,701 monthly observations from 9,000 European and non-EU stocks from 2015 to 2019. We rely on Rosenbaum and Rubin (1983) PSM to calibrate the sample composition on the probability of being treated. The resulting sample is based on 243,335 monthly observation. $analyst_{i,t}$ is the number of analysts that publish an estimate on the earning-per-share of the stock for each month, $spread_{i,t}$ is the bid-ask spread in bps, Market cap. is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization, Volatility represents the twelve-month historical volatility, Free float is the percentage of free floating shares on all outstanding shares, Institutional is the percentage of shares held by institutional investors, Short ratio is the ratio between the number of institutional seller and buyer for the stock and $r_{i,m,t}$ is the monthly log-return for the market index of stock *i*. The Table shows the results for full sample and, for the sake of simplicity, large cap sub-sample only. Results for the remaining market cap sub-samples are available from the authors upon request. Standard errors are clustered according to Petersen (2009).

Variable	(M35) $analyst_{i,t}$	(M36) $analyst_{i,t}$	(M37) $spread_{i,t}$	(M38) $spread_{i,t}$
$mifid_t$	0.089***	4.721***	3.107***	-0.376***
	(3.189)	(47.411)	(6.231)	(-4.201)
eu_i	1.469***	7.345***	45.423***	5.827***
	(9.345)	(110.530)	(23.858)	(13.342)
$mifid_t * eu_i$	-0.575***	-2.624***	8.325***	-0.069
	(-9.371)	(-21.923)	(6.011)	(-0.314)
Market capitalization	1.072***	0.0169**	-21.900***	-1.816***
	(27.988)	(2.261)	(-41.323)	(-13.976)
Turnover	0.022	0.147***	-3.043***	-0.528**
	(1.468)	(9.850)	(-3.658)	(-2.356)
Volatility	0.218	-1.889***	-8.578*	0.711
	(1.032)	(-23.884)	(-1.811)	(0.787)
Free float	0.016***	-0.028***	-0.077***	-0.016***
	(7.682)	(-87.914)	(-2.921)	(-3.375)
Institutional	0.014***	-0.008***	-0.101***	-0.028***
	(10.522)	(-38.642)	(-6.808)	(-9.086)
Short ratio	0.008	-0.524***	2.158***	0.136
	(0.805)	(-20.570)	(5.323)	(0.988)
$r_{i,m,t}$	-0.574***	-0.730***	-30.578***	-3.862***
	(-9.721)	(-4.161)	(-14.285)	(-7.610)
Constant	-3.066***	2.712***	194.673***	29.066***
	(-9.886)	(32.993)	(38.246)	(20.922)
Obs.	243,335	62,127	243,335	62,127
R-squared	48.01%	36.65%	31.92%	18.61%
Year-Month FE	YES	YES	YES	YES
Country-Firm FE	NO	NO	NO	NO
Sample	Full sample	Large-cap	Full sample	Large-cap

T-values are in parentheses
*** p<.01, ** p<.05, * p<.1

Table 16 – Robusteness' check on liquidity with Amihud (2002) illiquidity measure

The Table presents the estimates of the model described in Equation 2 where the dependent variable is $aill_{i,t}$. The sample is based on 332,701 monthly observations from 9,000 European countries (Treatment), US and Japan (Control). $aill_{i,t}$ is the Amihud (2002) illiquidity measure equal to $aill_{i,t} = \frac{|r_{i,t}|}{turnover_{i,t}}$, $mifid_t$ is a dummy variable equal to one for observations after January 1, 2018 and zero otherwise, eu_i is a dummy variable equal to one for EU stocks and zero otherwise. Market capitalization is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization, Volatility is the historical daily volatility, Free float is the percentage of free floating shares on all outstanding shares, Institutional is the percentage of shares held by institutional investors, Short ratio is the ratio between the number of institutional seller and buyer for the stock and $r_{i,m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

	(M39)	(M40)	(M41)
Variable	$aill_{i,t}$	$aill_{i,t}$	$aill_{i,t}$
$mifid_t$	-0.035*	-0.031	0.297***
	(-1.645)	(-1.479)	(10.017)
eu_i	5.215***	4.251***	
	(28.220)	(4.500)	
$mifid_t * eu_i$	0.468***	0.490***	0.505***
	(6.086)	(6.382)	(6.518)
Market capitalization	-0.247***	-0.227***	-0.298***
	(-10.637)	(-11.166)	(-9.857)
Volatility	-0.262	-0.344**	-0.107
	(-1.630)	(-2.429)	(-0.554)
Free float	-0.013***	-0.014***	-0.011***
	(-7.812)	(-9.152)	(-5.980)
Institutional	-0.005***	-0.006***	-0.002
	(-4.676)	(-5.766)	(-1.470)
Short ratio	-0.002	-0.002	-0.003
	(-0.088)	(-0.085)	(-0.114)
$r_{i,m,t}$	-2.041***	-2.069***	-2.056***
	(-11.625)	(-11.774)	(-11.703)
Constant	5.236***	5.393***	5.812***
	(19.336)	(20.694)	(18.717)
Obs.	332,701	332,701	332,701
R-squared	15.2%	36.3%	6.70%
Year-Month FE	YES	YES	YES
Country-Firm FE	NO	Country	Firm

T-values are in parentheses
*** p<.01, ** p<.05, * p<.1

Table 17 – Robusteness' check on liquidity with Amihud (2002) illiquidity measure on sub-samples

The Table presents the estimates of the model described in Equation 2 where the dependent variable is $aill_{i,t}$. The sample is based on a data set of circa 332,701 monthly observations from 9,000 stocks for European countries (Treatment), US and Japan (Control) from 2015 to 2019. Sub-samples are organized by market capitalization: Micro-cap (less than 300 mln euros), Small-cap (between 300 mln and 1 bln euros), Mid-cap (between 1 bln and 3.5 bln euros) and Large-cap (greater than 3.5 bln euros). Standard errors are clustered by firm according to Petersen (2009). $aill_{i,t}$ is the Amihud (2002) illiquidity measure equal to $aill_{i,t} = \frac{|r_{i,t}|}{turnover_{i,t}}$, $mifid_t$ is a dummy variable equal to one for observations after January 1, 2018 and zero otherwise, eu_i is a dummy variable equal to one for EU stocks and zero otherwise. Market capitalization is the natural logarithm of stocks' market capitalization and Turnover is the traded volume expressed in percentage points of market capitalization, Volatility is the historical daily volatility, Free float is the percentage of free floating shares on all outstanding shares, Institutional is the percentage of shares held by institutional investors, Short ratio is the ratio between the number of institutional seller and buyer for the stock and $r_{i,m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

	(M42)	(M43)	(M44)	(M45)
Variable	Micro-cap	Small-cap	Mid-cap	Large-cap
$mifid_t$	0.610***	0.368***	0.345***	0.357***
	(4.683)	(6.449)	(9.209)	(3.968)
eu_i	4.865***	3.056***	2.132***	2.185***
	(21.129)	(21.758)	(15.663)	(5.890)
$mifid_t * eu_i$	1.035***	0.127	-0.094	0.008
	(6.035)	(1.400)	(-1.481)	(0.104)
Market capitalization	-0.459***	-0.289***	-0.108***	0.211***
	(-7.938)	(-6.949)	(-4.247)	(3.262)
Volatility	-0.762***	-0.039	0.090	0.844**
	(-3.113)	(-0.428)	(1.010)	(2.029)
Free float	-0.017***	-0.014***	-0.010***	-0.002
	(-5.143)	(-9.117)	(-6.807)	(-0.803)
Institutional	-0.007***	-0.005***	-0.005***	-0.016***
	(-3.185)	(-5.989)	(-7.811)	(-11.004)
Short ratio	-0.052	0.008	0.061**	-0.202*
	(-1.641)	(0.230)	(2.030)	(-1.759)
$r_{i,m,t}$	-4.295***	-1.440***	-0.509***	-0.492**
	(-9.256)	(-6.758)	(-3.768)	(-2.225)
Constant	6.135***	4.442***	2.825***	1.592***
	(14.808)	(15.236)	(11.668)	(2.726)
Obs.	75,056	65,314	63,631	74,134
R-squared	16.5%	23.7%	21.4%	6.90%
Year-Month FE	YES	YES	YES	YES
Country-Firm FE	NO	NO	NO	NO

T-values are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 18 – Robustness' checks for price efficiency with Pastor-Stambaugh (2003)

The Table presents the estimates for the model described in Equation 4. The dependent variable is $ret_{i,t}$and represents the log-return for stock *i* in time *t*. The sample is based on 2,333,547 daily observations from 2,770 stock for European countries (Treatment), US and Japan (Control) from 2016 to 2019. Market capitalization is the natural logarithm of daily market capitalization, $turn_{i,t}$is the traded volume for stock *i* in time *t*, $sign(ret_{i,t-1})$ represents the direction of log returns in day $t-1$ for stock *i*, Volatility is the historical daily volatility and $r_{i,m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

Variable	(M46) $ret_{i,t}$	(M47) $ret_{i,t}$	(M48) $ret_{i,t}$	(M49) $ret_{i,t}$
$ret_{i,t}$	0	-.001	-.001	-.001
	(-.268)	(-.473)	(-.47)	(-.63)
$mifid_{i,t}$	-.039***	-.039***	-.039***	-.076***
	(-7.742)	(-7.749)	(-7.749)	(-12.084)
$eu_{i,t}$	.004	.004		
	(.86)	(.858)		
$mifid_{i,t} * eu_{i,t}$	.001	.001	.001	.023***
	(.136)	(.144)	(.107)	(3.396)
$mifid_{i,t} * ret_{i,t-1}$		.005*	.005*	.004
		(1.818)	(1.821)	(1.434)
$eu_{i,t} * ret_{i,t-1}$		0	0	-.001
		(-.032)	(-.031)	(-.442)
$mifid_{i,t} * eu_{i,t} * ret_{i,t-1}$		-.005	-.005	-.005
		(-1.472)	(-1.471)	(-1.566)
$sign(ret_{i,t-1}) * turn_{i,t-1}$	-.559	-.559	-.56	-.823
	(-1.019)	(-1.018)	(-1.018)	(-1.472)
$sign(ret_{i,t-1}) * turn_{i,t-1} * eu_{i,t}$	1.03	1.029	1.028	.74
	(1.05)	(1.049)	(1.049)	(.757)
$sign(ret_{i,t-1}) * turn_{i,t-1} * mifid_{i,t}$	.52	.52	.521	.538
	(.869)	(.869)	(.871)	(.918)
$sign(ret_{i,t-1}) * turn_{i,t-1} * eu_{i,t} * mifid_{i,t}$	-1.03	-1.029	-1.031	-1.293
	(-.903)	(-.903)	(-.906)	(-1.148)
Market capitalization	.029***	.029***	.029***	.268***
	(21.403)	(21.41)	(21.832)	(27.207)
Volatility	.001	.001	.001	.03***
	(.396)	(.398)	(.424)	(11.415)
$r_{i,m,t}$	68.715***	68.716***	68.713***	68.608***
	(98.177)	(98.176)	(98.183)	(98.212)
Constant	-.159***	-.159***	-.094***	-1.762***
	(-13.549)	(-13.558)	(-3.769)	(-27.394)
Obs.	2,333,543	2,333,543	2,333,543	2,333,543
R-squared	11.20%	11.23%	11.26%	11.41%
Std. Errors	Firm-clustered	Firm-clustered	Firm-clustered	Firm-clustered
Year-Month FE	YES	YES	YES	YES
Country-Firm FE	NO	NO	Country	Firm

T-values are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 19 - Robustness checks for price efficiency with Pastor-Stambaugh (2003) on sub-samples

The Table presents the estimates for the model described in Equation 4. The dependent variable is $ret_{i,t}$ and represents the log-return for stock *i* in time *t*. The sample is based on 2,333,547 daily observations from 2,770 stock for European countries (Treatment), US and Japan (Control) from 2016 to 2019. Sub-samples are organized by market capitalization: Micro-cap (less than 300 mln euros), Small-cap (between 300 mln and 1 bln euros), Mid-cap (between 1 bln and 3.5 bln euros) and Large-cap (greater than 3.5 bln euros). Market capitalization is the natural logarithm of daily market capitalization, $turn_{i,t}$ is the traded volume for stock *i* in time *t*, $sign(ret_{i,t-1})$ represents the direction of log returns in day $t-1$ for stock *i*, Volatility is the historical daily volatility and $r_{i,m,t}$ is the local index monthly return. Standard errors are clustered by firm according to Petersen (2009).

Variable	(M50) Micro-cap	(M51) Small-cap	(M52) Mid-cap	(M53) Large-cap
$ret_{i,t}$	-.001	-.001	-.002	.001
	(-.273)	(-.264)	(-.652)	(.182)
$mifid_{i,t}$	-.018	-.054***	-.042***	-.03***
	(-.941)	(-4.934)	(-4.976)	(-3.939)
$eu_{i,t}$	.139***	-.002	.012	-.014**
	(6.784)	(-.285)	(1.359)	(-2.163)
$mifid_{i,t} * eu_{i,t}$	-.014	.021*	-.002	.018**
	(-.682)	(1.766)	(-.226)	(2.228)
$mifid_{i,t} * ret_{i,t-1}$	.01	.01**	-.001	.004
	(1.071)	(1.96)	(-.34)	(.798)
$eu_{i,t} * ret_{i,t-1}$	-.001	-.004	.004	-.003
	(-.135)	(-.92)	(.97)	(-.699)
$mifid_{i,t} * eu_{i,t} * ret_{i,t-1}$	-.011	-.007	-.003	-.003
	(-1.083)	(-1.126)	(-.509)	(-.494)
$sign(ret_{i,t-1}) * turn_{i,t-1}$	-1.802	.409	-.153	-.339
	(-1.092)	(.395)	(-.198)	(-.446)
$sign(ret_{i,t-1}) * turn_{i,t-1} * eu_{i,t}$	.938	1.166	1.23	1.676
	(.464)	(.489)	(.93)	(1.239)
$sign(ret_{i,t-1}) * turn_{i,t-1} * mifid_{i,t}$	1.634	-1.384	.372	.741
	(1.084)	(-.912)	(.396)	(.692)
$sign(ret_{i,t-1}) * turn_{i,t-1} * eu_{i,t} * mifid_{i,t}$	-.698	-2.385	-1.283	-1.160
	(-.336)	(-.847)	(-.637)	(-1.253)
Market capitalization	.148***	.018**	.108***	.022***
	(17.916)	(2.165)	(10.697)	(7.059)
Volatility	.018***	.016***	.025***	.015***
	(4.244)	(3.547)	(5.338)	(2.677)
$r_{i,m,t}$	41.886***	71.177***	83.476***	89.03***
	(48.099)	(57.005)	(72.729)	(76.559)
Constant	-.806***	-.109*	-.807***	-.158***
	(-17.161)	(-1.903)	(-10.325)	(-5.092)
Obs.	874,195	512,746	495,507	442,811
R-squared	3.22%	12.12%	20.39%	28.10%
Std. Errors	Firm-clustered	Firm-clustered	Firm-clustered	Firm-clustered
Year-Month FE	YES	YES	YES	YES
Country-Firm FE	NO	NO	NO	NO

T-values are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1