MAD about Transparency? The Impact of MAD and TPD Directives on Investor Overconfidence, Herding, and Stock Market Efficiency in the EU.

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Abstract

We study the effectiveness of two crucial EU financial reforms, the Market Abuse Directive (MAD) and the Transparency Directive (TPD), on one of their ultimate aims, i.e. increasing the information efficiency of the pan-EU capital market. For a sample of daily stock-level data for ten EU stock markets, we empirically document that, according to our measure, the EU capital market was not efficient pre-MAD, i.e. we observe the prevalence of investors anti-herding in stocks. MAD implementation is shown to have eliminated this inefficiency, with the subsequent TPD enactment being effectively redundant and therefore not affecting the markets further. Pre-MAD, markets are shown to be driven by overconfidence and low self-control of investors, while MAD introduction appears to have reduced the risk of trading against insiders and improved the information content of trades, leading to improved liquidity and efficiency.

Keywords: Herding, Stock Market Efficiency, Insider Trading, Regulatory Reforms, MAD, TPD, FSAP

JEL Classification: G12, G14, G18, G40

1. Introduction

At the dawn of the third millennium the European Union embarked on a process of accelerated capital market integration, driven by the 1999 Financial Services Action Plan (FSAP), a comprehensive program of 42 reforms aimed at creating a harmonised and coherent regulatory framework for the pan-European capital market; this was further facilitated by the enactment of the 2001 Lamfalussy Report which recommended a new law-making approach to allow for timely regulatory responses to capital market developments (Moloney, 2003, 2008). Two of the most important directives emerging from this process were the Market Abuse Directive (MAD) and the Transparency Directive (TPD). While the former was aimed at reducing illegal insider trading and market manipulation by trades and (mis)information, and therefore addressed the issue of private information utilisation, the latter was designed to boost the provision of company information to investors, by increasing the timeliness, frequency and comparability of public information releases, and the enforcement of those rules. Therefore, these two complementary regulatory measures, aimed at private and public information, respectively, would be expected to have a potentially significant impact on the functioning of the pan-European capital market, and have been argued to be the most relevant for market-wide phenomena, as compared to other parts of the FSAP (Christensen et al., 2016).[1]

In this study, we investigate the impact of MAD and TPD as those directives which aimed at improving the European capital market information environment, on one of their explicit end-goals, i.e. the informational efficiency of stock markets in the EU. On purely

[1] Other crucial reforms were the Prospectus Directive, the Market in Financial Instruments Directive (MiIFID), and the Takeover Directive. Several years later, in July 2016 and January 2018 respectively, the European Commission amended MAD and MiFID by enacting the Market Abuse Regulation (MAR) and MiFID II (Sidley, 2016: ESMA 2021). The financial regulatory framework was also significantly shaped by the compulsory adoption of International Financial Reporting Standards (IFRS) by EU firms for fiscal years starting in 2005 (see De George et al., 2016, and Leuz and Wysocki, 2016, for comprehensive reviews of the IFRS literature.)

theoretical grounds, it is uncertain if, and how, MAD and TPD would affect efficiency, therefore this question requires a comprehensive empirical investigation. For instance, MAD could be beneficial to efficiency as limiting insider trading would lower the risk of trading against a better-informed party, thus attracting more trades (Ausubel, 1990; Fishman and Hagerty, 1992) and boosting the overall liquidity of the stock market (Chordia et al., 2008). Furthermore, a MAD-induced decline in market manipulations via misleading trades and misinformation could also make available information more credible and more likely to trade on, similarly following trades by informed investors would become less risky, hence contributing to a quicker adjustment of prices to information. On the other hand, limits on insider trading could hamper the flow of information to the market (Manne, 1966); similarly, the perception of lower risk and higher reliability of public information and observed trades could attract more noise traders to the market, hence reducing its informational efficiency (DeLong et al, 1990). Also for TPD, a successful provision of more and better information could result in information overload and boundedly-rational traders resorting to rational ignorance and decision making based only a subset of available information (Simon, 1957; Kahneman, 1973; Fiske 1995; Blankespoor, 2020), or even on non-rational motives such as sentiment (Baker and Wurgler, 2006). In sum, the impact of MAD and TPD on market efficiency depends on conflicting forces and therefore an evaluation of their final net effects requires an empirical investigation.

Despite the combined EU capital market being second-largest in the world by some counts,[2] and in spite of the potential relevance of MAD and TPD for investors, regulators, and the broader EU economy, empirical evidence on the effectiveness of MAD and TPS is

[2] Measured by the domestic equity market capitalization in December 2019 (to avoid the COVID pandemic impact skewing the data), the combined EU stock market amounted to USD 12,958 Bn (UDS 8,776 Bn excluding the UK; however, the UK remained part of the EU throughout our sample, until 31 January 2020), surpassed only by the combined US equity market (USD 37,099 Bn) and being comparable to the combined Chinese equity market (USD 8,516 Bn, or USD 13,415 when including Hong Kong) (focus.world-exchanges.org).

scarce. Cumming et al. (2011) show that market liquidity benefited from legal changes to market abuse and insider trading regulations, and Christensen et al. (2016) confirm the liquidity-enhancing effects of MAD and TPD, albeit observed only in selected EU countries. Watanabe et al. (2019) further demonstrate that MAD and TPD improved stock market price informativeness, while MAD was also shown to have reduced insider trading (Aussenegg et al., 2018, Prevoo and Weel, 2010) and limited conflict of interests in securities firms (Dubois et al., 2014). However, Gębka et al. (2017) do not find any significant changes in the profitability of reported insiders' trades post-MAD.

The broader literature on the impact of regulations on equity markets is also inconclusive. For instance, insider trading has been argued to be socially beneficial, as (i) profits from insider trading can be seen as a form of manager compensation and (ii) trades by insiders are a channel for information to reach the market and move prices towards their fundamental values (Manne, 1966, Carlton and Fischel, 1983, Leland, 1992); on the other hand, other scholars highlighted flawed incentives insider trading creates and a negative impact of insiders' activity on outside investors (e.g., Ausubel, 1990; Leland, 1992; Fried, 1998; Bebchuk and Fried, 2003), as it increases transaction costs and lowers market efficiency due to the risk other market participants are facing when trading against better informed insiders (Glosten and Milgrom, 1985, Kyle, 1985). Empirically, the evidence that insiders can profit from their non-public information access is mixed (Seyhun, 1998). Similarly, regulation of corporate disclosure has been justified as a means to address externalities, ensure cost savings (e.g. through standardization of reporting), improve corporate credibility and commitment through public enforcement, and limit social costs resulting from agency conflicts (see Leuz, 2010, for a review). However, regulation is recognized to have the potential to do more harm than good, for instance because compliance by firms and enforcement by public agencies can be very costly, while regulators are not sufficiently informed about costs and benefits and are subject to lobbying and political pressures. The empirical evidence on information disclosure is inconclusive (see., e.g., De George et al. (2016) for an IFRS-related literature review), while Leuz and Wysocki (2016) also observe that what is still needed is more research into market-wide effects and causal impact of regulations. Our study responds to this call.

Our paper contributes to numerous strands of the literature. Firstly, we expand our collective understanding about the impact of MAD and TPD on market-wide phenomena, in particular on market efficiency rather than liquidity or price informativeness as in prior studies; our focus on efficiency corresponds to the explicitly stated aims of both directives. More broadly, our research on stock market consequences of regulatory reforms contributes to the discussion on evidence-based policy making (Leuz, 2018). We also contribute to the insider trading literature by providing new evidence on the effectiveness of a regulatory intervention, i.e. the MAD, aimed at curbing unlawful exploitation of company-internal information. Furthermore, we provide new insights about the conditions for investor herding and anti-herding, contributing to that strand of the literature. Lastly, more generally, we approach the market manipulation and information disclosure literature from the angle of behavioural accounting and finance: while the overwhelming majority of studies implicitly assumes that trading decisions and their market-level outcomes are driven purely by rational decision motives, we explore the importance of irrational motivations, such as overconfidence and fads-driven investor herding, and how their impact on market efficiency is affected by reforms addressing private and public information availability and utilization.

We employ the standard Chang et al. (2000) empirical model of irrational market-wide investor herding and anti-herding utilising daily data on prices of individual stocks in 10 European markets in the period 2 January 2003 - 31 December 2011. Our main results indicate that those markets displayed a significant amount of anti-herding prior to the introduction of MAD, however, this reform eliminated that market inefficiency. The subsequent enactment of the TPD has had no significant effect on EU market efficiency. These results are not driven by the 2007-9 financial crisis or by concurrent reforms, namely the MiFID and the IFRS, and we further document that pre-MAD excessive return dispersion which MAD introduction eliminated is primarily observed in down markets, low volume regimes, and is independent from volatility levels. Our further analysis finds evidence of markets being driven by investor overconfidence and localized herding pre-MAD, phenomena eliminated by MAD introduction as MAD boosted market liquidity by reducing the risk of trading against better-informed insiders and made trading on fundamental information more prevalent by improving information credibility via limiting market manipulations. Lastly, we find that TPD had no significant effect on the form of market inefficiency studies here because the preceding MAD successfully reduced this inefficiency, i.e., rather than being poorly enforced or resulting in sluggish price reactions to information, TPD was simply not needed at that timepoint to curb excessive return dispersion driven by overconfidence and localised herding by investors.

The remainder of this paper is structured as follows: In section 2 we review the literature on herding and anti-herding as well as the MAD and TPD directives and develop hypotheses about their potential impact on stock market efficiency. Section 3 presents the data and empirical methods used. Baseline results and robustness checks are presented in Section 4 and 5, respectively, while in Section 6 we empirically explore potential explanations of those results. Section 7 summarises and concludes.

2. Literature review and research questions

2.1. Herding in financial markets

Herding can be defined as a phenomenon whereby investors (partially) ignore their individual believes about financial assets and instead trade by imitating other investors' decisions (Hirshleifer and Teoh, 2003). What is immediately apparent from this definition is that such imitating behaviour can be justified by other investors' objectively superior information endowment (or information processing skills) and therefore would be beneficial for market efficiency. Conversely, it can be only a misperception of alleged informational superiority of others, acting on which would lead to prices deviating from fundamental values and displaying excess volatility, to the detriment of market efficiency. In addition, traders' investment decisions may be mirroring those of others intentionally or be highly correlated by coincidence, hence the literature distinguish between intentional and spurious herding (Kallinterakis and Gregoriou, 2017 review both the theoretical arguments and empirical findings on herding). Where the former emerges due to investors perceiving their peers to be better informed, it may result in suppression of their own information, as traders ignore own believes and follow the crowd instead; this could lead to suppressed information not being incorporated into stock prices and markets being less efficient (Banerjee, 1992; Bikhchandani et al., 1992, Devenow and Welch, 1996). Another reason for traders to consciously engage in herding is due to performance assessment measures they face, which is especially relevant for professional investors whose reputation and renumeration depends on how their financial performance compares to that of their peers (Scharfstein and Stein, 1990, Graham, 1999, Welch, 2000). In such a scenario, it can be rational for a trader to follow their peers who are considered better informed (or have superior capacity to utilise otherwise symmetrically available information) or mimic the average asset allocation decision of the relevant comparison group (e.g., an index of a specific industry or style) to minimise the risk of performing significantly worse than the average peer or a market benchmark.

However, in certain situations traders will appear to act in unison without a conscious intention to mimic each other's behaviour; rather, the observed correlation will be driven by an exogenous factor (spurious herding). Such a factor could be the traders' homogeneity, e.g. similarity of their socio-economic and educational background, of the regulatory environment and performance management practices they all face, or of information sources, leading to individual investment decisions being similar to those of their peers (De Bondt and Teh, 1997; Hirshleifer and Teoh. 2003; Voronkova and Bohl, 2005). Another source of such spurious consensus would be trading based on styles or stock characteristics, whereby a substantial number of investors simultaneously, but independently from one another, move out of and into a specific asset class, e.g. value vs. growth stocks, employing momentum or contrarian strategy, tech sector, ESG/ethical investment, etc. (Bennett et al., 2003, Choi and Sias, 2009).

For the purpose of this study, as we are interested in market efficiency across a number of EU countries, we will concentrate only on those herding manifestations which affect the efficient information aggregation by stock markets. Furthermore, this necessitates the choice of a herding measure which is both market-wide and for which data for our sample would be available. The herding measure of Chang et al. (2000) meets these criteria. These authors, building on Christie and Huang (1995), demonstrate analytically that, when asset prices adhere to a rational pricing model such as the CAPM, herding will be non-existing. However, when investors engage in ignoring their believes and follow the market instead, a behaviour assumed to be mostly prevalent when absolute market returns are high, this herding will manifest itself as an excessive similarity among stock returns, i.e. their cross-sectional return dispersion will be too low. This reasoning, of which a more detailed exposition we provide in Section 3.2, allows for an empirical identification of market-wide herding using daily stock price data alone.[3] Additionally, several studies observed the opposite effect, i.e. stock returns being excessively dissimilar from one another, compared to what a rational pricing model would imply; we use the term “anti-herding” to describe this excessive cross-sectional return dispersion.[4] Gebka and Wohar (2013) hypothesise that anti-herding could be due to investors’ overconfidence, whereby they irrationally ignore information embedded in market prices and over-rely on own assessment instead, or localised herding whereby some investors move jointly into and out of a subset of stocks (e.g., due to investors following traders assumed to be more informed, pursuing a specific style rotation strategy, flight to quality/liquidity, etc.), this localised selling/ buying pressure causing respective prices to deviate excessively from the market consensus in opposite directions.

Empirical evidence on the existence of herding is vast but mixed (see Kallinterakis and Gregoriou, 2017, for a review). In general, herding tends to be found in emerging (e.g., Chang et al., 2000, Goodfellow et al., 2009, Chiang et al., 2010, Chiang and Zheng, 2010, Economou et al., 2011, Yao et al., 2014) more than mature markets, and to be affected by crisis outbreaks (Klein, 2013, Mobarek et al., 2014, Galariotis et al., 2015, Cui et al., 2019), up versus down markets, volatility regimes and levels of trading volume (Goodfellow et al., 2009, Holmes et al., 2013; Gavriilidis et al., 2013, Economou et al., 2015), although results are inconclusive as to which market regime is more likely to witness herding.

2.2. MAD and TPD directives

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[3] As Hirshleifer and Teoh (2003) rightly point out, herding is challenging to measure, especially if one wants to tease out the non-spurious and efficiency-related aspect of it. Some studies use data on investor portfolio holdings, an approach which originated with Lakonishok et al. (1992), however, its data requirements yield it unfeasible for most for market-wide studies as high frequency portfolio data on a large number of market participants is not available. Information on actual investors’ trades, as utilized e.g. in Grinblatt and Keloharju (2000) is even more difficult to obtain.

[4] Most of the stock market herding literature concentrates on finding excessive similarity in trades or resulting price movements and mostly ignores occurrences of anti-herding, also known as negative herding (Gebka and Wohar, 2013). Hence, insightful and detailed discussions of anti-herding are rather scarce. Notable exceptions include Effinger and Polborn (2001) and Levy (2004) who explicitly model anti-herding theoretically, and empirical studies, e.g., Babalos and Stavroyiannis (2015), Fang et al. (2017), Stavroyiannis and Babalos (2017), Goldstein and Zilberfarb (2021), and Ukpong et al. (2021).

The MAD and TPD considered in this study were the result of a long process of harmonization of capital markets regulations in the EU going back to at least 1977, which initially focused on disclosure by equity issuers seeking listing on a stock market (Moloney, 2003, 2008). A substantial push for further harmonisation occurred in the late 1990s in conjunction with the introduction of the common currency, and resulted in the 1999 Financial Serviced Action Plan (FSAP) as a set of 42 measures aimed at creating a coherent capital market regulatory environment, originating at the EU level rather than continuing the tradition of state-level harmonisation efforts. The implementation of FSAP was spurred by the 2001 Lamfalussy[5] report which proposed new legal approaches to speed up decision making in the EU. The plan initially consisted of several directives, to be implemented over a period of five years. Among the directives that address securities markets were the Market Abuse Directive (MAD), the Transparency Directive (TPD), the Prospectus Directive, the Market in Financial Instruments Directive, and the Takeover Directive. MAD and TPD are considered to be the most theoretically related to market-wide outcomes (Christensen et al., 2016), with markets' informational efficiency as studied here being a prominent manifestation of such an outcome.

The MAD aims at increasing market transparency and investors' confidence in markets by reducing insider dealing and market manipulation through trades and dissemination of (mis)information. It requires listed companies to make insider information publicly available as soon as possible, and corporate insiders to report their trades in securities of their companies in a timely manner. It also aimed at harmonising sanctions across the EU, and at strengthening enforcement of these rules by requiring member states to

[5] The Lamfalussy report was issued by the Committee of Wise Men on the Regulation of the European securities market, chaired by Baron Alexandre Lamfalussy, in February 2001. The report arranged for the implementation of a new framework that aimed to increase the involvement of stakeholders and institutions, in addition to improving the enforcement of state laws (Schaub, 2005).

have a dedicated and sufficiently empowered authority for this purpose (Council directive 2003/6/EC, 2003, Christensen et al., 2016).

The TPD aims at increasing the confidence in capital markets by providing investors with quality and abundant information, through reporting requirements and stricter enforcement of these rules. Regular flow of information, ensured by standardised content and more frequent timelines of reporting, is meant to improve transparency by securities' issuers and enable comparability of information releases. For instance, in addition to annual and half-year reporting, TPD requires interim management statements, as well as timely information releases on major changes in shareholdings, following homogenised procedures, it also requires non-discrimination of groups of shareholders in terms of information access and rights exercise. Maybe more importantly, TPD also requires member states to designate and sufficiently endow a "competent authority" for monitoring and enforcing these rules (Council directive 2004/109/EC, 2004).[6]

Despite the practical and regulatory importance of MAD and TPD, empirical studies investigating the consequences of those FSAP directives are rather scarce. Cumming et al. (2011) constructed indices of stock exchange rules regarding insider trading and market manipulation which captured, among other regulations, the MAD effect, and established empirically that those rules significantly affect market-wide liquidity.[7] Christensen et al. (2016), using a different empirical approach, also found evidence of the effectiveness of MAD, and of TPD, represented by an improvement in stock market liquidity around the time each of these directives was signed into the national law: they found the effect of each to be

[6] In fact, Christensen et al. (2016) argue that enhanced monitoring and enforcement were the predominant contribution of the TPD, as insider trading and reporting rules existed in the EU prior to TPD introduction to a large extent.

[7] The approach underlying Cumming et al. (2011) is that MAD was an initial stage of a longer process which was finalised by enactment of the Markets in Financial Instruments Directive (MIFiD) and that, therefore, these two directives need to be considered jointly; in particular, they argue that MIFiD was instrumental in the effective and final implementation of MAD rules.

of similar magnitude, and more pronounced in countries where prior regulatory quality was higher and where the post-reform implementation was stronger. Similarly, Aussenegg et al. (2018) reported evidence indicating that stronger MAD enforcement leads to less equity mispricing which insiders would trade on to take advantage of, and Watanabe et al. (2019) found that both MAD and TPD introduction increased price informativeness, as measured by price synchronicity, especially where the regulatory environment was strong otherwise. For stocks traded in Amsterdam, Prevoo and Weel (2010) reported evidence of MAD effectiveness, as the pre-announcement information leakage evidencing insider trading was weaker post-MAD, predominantly in smaller and technology stocks. Dubois et al. (2014) demonstrate that MAD was effective in curbing the conflict of interest in securities firms, as evidenced by a post-MAD reduction in prior overly optimistic investment advice, a finding most pronounced in countries where MAD-related sanctions and enforcement were strong. On the other hand, Gębka et al. (2017) find no evidence of reductions in the profitability of reported insiders' trades after the adoption of MAD.

2.3. The potential impact of MAD and TPD on stock market efficiency

As is apparent and very explicit from the text of both MAD and TPD directives, both are aimed at boosting efficiency of the EU capital market. For instance, the MAD directive (Council directive 2003/6/EC, 2003) states: "*An integrated and efficient financial market requires market integrity. […] Market abuse harms the integrity of financial markets and public confidence in securities and derivatives*." Hence, curbing market abuse is only a means to improve market integrity, which in turn leads to the "efficient financial market". Similarly, the TPD (Council directive 2004/109/EC, 2004) states that better information allows for rational investor decisions and improved market efficiency: "*The disclosure of accurate, comprehensive and timely information about security issuers builds sustained* *investor confidence and allows an informed assessment of their business performance and assets. This enhances both investor protection and market efficiency*."

If the adoption of MAD and TPD was successful in achieving their aim of improving the efficiency of financial markets, we would expect the behaviour of stock prices, encapsulated here by the cross-sectional dispersion of individual stock returns, to be in line with what a rational asset pricing model such as the CAPM would predict, i.e, a linear relationship between absolute market returns and the cross-sectional dispersion (as shown by Chang et al., 2000). Therefore, any form of nonlinearity, be it positive or negative, is a form of market inefficiency which MAD and TPD, if effective, would be expected to curb. A negative nonlinear relationship reflects insufficient return dispersion indicative of aggregate stock market herding, whereby investors choose to ignore their own beliefs and follow the aggregate market (Chang et al., 2000). A positive nonlinear relationship indicated by excessive return dissimilarities (i.e., dispersion) could be due to localized herding, whereby a group of investors engage in synchronized trading in a subset of stocks, for instance due to following informed traders, flight to quality, or overconfidence of some investors (Gebka and Wohar, 2013).

A natural first step would be therefore to test for the presence of stock market inefficiency, herding or anti-herding, prior to the first reform. Accordingly, our research question would be:

Q1: Does inefficiency prevail in the sampled European markets and, if it does, in which form?

MAD is expected to affect aggregate market efficiency through two different mechanisms. Firstly, curbing trading on insider information could have the effect of reducing the risk faced by other market participants, i.e., of trading against better informed insiders and being effectively expropriated due to their information disadvantage (Ausubel, 1990; Fishman and Hagerty, 1992). Hence, If MAD was effective, this risk would be reduced, attracting more trades from risk-averse investors and boosting market liquidity, hence positively contributing to the overall market efficiency (Chordia et al., 2008). However, if uninformed speculators who trade on noise rather than information were attracted, this could cause a deterioration in market efficiency (DeLong et al., 1990). Equally, there has been a long debate in the literature, going back at least to Manne (1966), if insider trading is not a positive contributor to market efficiency, as it provides a channel through which price-relevant information reaches the market and is incorporated into prices. In this context, there is ample evidence that investors rely heavily on insider trading activities as these activities convey valuable information for market participants (Lauterbach et al., 1993; Chordia et al., 2008). The empirical literature of insider trading has found that these activities are a valuable source of information for investors and a driver for increased stock market liquidity (Chen et al., 2014). Herding can arise as a human heuristic to deal with information opaqueness; equally, overconfidence is more likely to flourish if there are no hard facts at hand to curb one's irrational believes. Therefore, if the ban of insider trading deprives the market of a valuable source of information, markets would be more likely to be driven by irrational motives rather than fundamental information. This leaves the theoretical direction of the MAD effect on aggregate market efficiency undetermined and renders it as a valid empirical question.

The second mechanism through which MAD could affect market efficiency is the curbing of market manipulation by misleading trades or misinformation. This would make publicly available information more credible as an indicator of fundamental news about companies, hence enhancing trading on information rather than noise and making markets more efficient. It would also make the observed trades more indicative of the changes in underlying fundamentals, allowing less informed investors to follow those observed price movements and hence contributing to quicker adjustments of prices to news, again making the markets more efficient. However, if those uninformed investors followed trades driven by non-informational motives, such as liquidity needs or portfolio rebalancing, mistaking them for signals of news arrivals, it could destabilise the market and make it less efficient as a result. Overall, the effect of MAD would be a function of those two mechanisms and its impact of efficiency could be positive or negative and cannot be determined on theoretical grounds alone. Hence, we pose the following question:

Q2: In case markets experienced inefficiency, how did the adoption of MAD affect this phenomenon?

As for the TPD, one would expect it to have a positive impact on market efficiency, given its aim to increase the availability of information to investors. This, in turn, would boost investors' confidence in their own judgements, and precision of these judgements, about companies' fundamentals, leading them to trade on information rather than irrational motives, e.g., herding on stock market movements or overconfidently supressing market information. From a different perspective, additional information arising from increased disclosure might lead to unintended negative consequences. For instance, the literature provides ample evidence on the limited ability of human beings to process information; human beings lose their attention when they are introduced to vast amounts of information, as attention is a demanding activity that requires major mental effort. For instance, Kahneman (1973) highlights several biases that can arise due to limits in humans' ability to analyse information, while Hirshleifer and Teoh (2003) argue that attention is associated with encoding and processing of public information. In a recent study Blankespoor (2020) details how processing costs of disclosure can lead corporate public information to become a form of private information. In a similar vein, Fiske (1995) asserts that focusing on one particular piece of information requires individuals to exclude other pieces of information. Moreover, the literature on psychology has also discussed how individuals learn by observing; Lipe (1998), for instance, finds evidence that investors do not utilize all publicly available information, while Kruschke and Johansen (1999) argue, using theoretical and empirical methods, that the nonnormative and irrational behaviour of shifting attention from relevant information is an adaptation skill acquired by humans to the necessity of fast learning. It is therefore reasonable to expect some traders to, e.g., follow the aggregate market movement or rely on mental shortcuts to avoid mental efforts/ costs associated with the increased information availability brought about by TPD. Lastly, if member states failed to implement the monitoring and enforcing elements of the TPD this reform would not have had any effect. In sum, these competing conjectures about the effect of TPD on stock market efficiency necessitate an empirical investigation to reveal which effect is dominant. Accordingly, our third research question is:

Q3: How did the adoption of the Transparency Directive affect stock market efficiency?

3. Data and Methodology

3.1. Data

The decision on setting the investigation period of the study involves a trade-off between including a large number of observation to assure statistical efficiency of coefficient estimates versus risking an inclusion of confounding effects arising from other events which potentially affected herding but were not related to the reforms studied here. In a quarterly data setting, Christensen et al. (2016) conduct their analysis over the period 2001–2011, allowing for more than two years prior and after the adoption of the first and last country enactment date. We use daily data, which provides us with a much larger number of observations for a given time frame. This allows us to shorten the period pre- and post- the studied directives, which helps in isolating any confounding events that may have taken place. Our sample period starts on 2 January 2003, which is more than three years prior to the first country enactment of the MAD, and ends on 31 December 2011. In our sampling procedures, we include countries which have consistent daily data for at least 30 stocks as constituents of the market index, in order to ensure the robustness of daily estimates of the cross-sectional return dispersion. The European countries that satisfy this requirement are: Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Spain and the UK. Data on daily stock prices is obtained from Datastream while data on the implementation months of MAD and TPD is taken from Christensen et al. (2016).

3.2. Empirical model

In order to investigate the prevalence of deviations of stock market behaviour from what a rational asset pricing model would imply, we adopt the methodology of Chang et al. (2000) (CCK for short) designed to detect the presence of irrational stock market herding. These authors demonstrate analytically that, if asset prices follow a rational pricing model such as the CAPM, there should exist a linear positive relationship between absolute market returns and the cross-sectional absolute dispersion of individual stock returns (CSAD), defined as:

$$\mathrm{CSAD}_t = \frac{\sum_i^n |R_{i,t} - Rm_t|}{n} \qquad (1)$$

where $R_{i,t}$ denotes daily return on stock *i* at time *t*, Rm_t stands for the equally weighted market return at time *t* (an unbiased measure of the expected stock return), and n is the number of stocks for which returns are observed at time *t*. In the presence of irrational stock market herding, which is argued to be mostly prevalent when absolute market returns are high (Christie and Huang, 1995), stock prices will no longer adhere to CAPM and the linear relationship between CSAD and absolute market returns will be cease to hold. Consequently, as in presence of market-wide herding traders will excessively mimic each other's behaviour and stock returns will become too similar to one another, return dispersion will be lower than what CAPM would imply. More formally, the CSAD will be too low for high absolute market returns, and overall will increase at a decreasing, not constant, rate with the increase in absolute market returns. Therefore, this herding effect can be captured empirically by estimating the following model:

$$CSAD_t = \alpha_1 + \alpha_2|Rm_t| + \alpha_3(Rm_t)^2 + \varepsilon_t, \qquad (2)$$

with the presence of herding being indicated by a negative and significant α_3.

As CAPM implies a linear relationship between $CSAD_t$ and $|\mathrm{Rm_t}|$, a significant positive coefficient α_3 also indicates a type of market inefficiency as it implies a deviation from what a rational asset pricing model suggests. Gebka and Wohar (2013) refer to this case as "negative herding" and link it to overconfidence of investors, which would generate price movements away from the market consensus, or to localized herding, whereby some investors move out of and into subsets of stocks, increasing return dispersion. This negative herding, which we refer to as anti-herding henceforth, would result in cross-sectional return dispersion being too high (compared to what the CAPM would imply) rather than too low as in the case of herding. Hence, a positive and significant α_3 will be indicative of anti-herding.

We employ the above herding model in order to investigate the effects of adoption of two FSAP directives, MAD and TPD, on market efficiency. Given that countries differ in their resources and legal frameworks, this leads to a staggered adoption of those directives across countries. The timing of their adoptions is argued to be random – that is, there is no endogenously determined pattern in their staggered implementation – which allows to control for endogeneity concerns and reverse causality (Christensen et al., 2016, Leuz, 2018).[8] Our

[8] While staggered implementation helps to address concerns about endogeneity and reverse causality, it does not address the possibility that the herding coefficient has been trending over time and, hence, a change in its value is not due to the implementation of these reforms. Moreover, it does not control for the world financial crisis

model for the analysis of how MAD and TPD affected market efficiency is therefore an extension of model (3), applied to the panel of *j*=10 countries, as follows:[9]

$$CSAD_{t,j} = \gamma_1 + \gamma_2|Rm_{t,j}| + \gamma_3\left(Rm_{t,j}\right)^2 + \qquad (3)$$
$$+ \gamma_4 MAD_{t,j}, + \gamma_5 MAD_{t,j} * |Rm_{t,j}| + \gamma_6 MAD_{t,j} * \left(Rm_{t,j}\right)^2 +$$
$$+ \gamma_7 TPD_{t,j} + \gamma_8 TPD_{t,j} * |Rm_{t,j}| + \gamma_9 TPD_{t,j} * (Rm_{t,j})^2 + \varepsilon_{t,j}$$

To investigate the effect of MAD, we include a dummy variable denoted by $MAD_{t,i}$,[10] which takes the value of 1 after the adoption of MAD and 0 otherwise, an interaction term $MAD_{t,j} * |Rm_{t,j}|$ and an interaction term $MAD_{t,j} * (Rm_{t,j})^2$. Pre-MAD, market-wide herding is captured by parameter γ_3: it should be negative (positive) if the market does not follow rational asset pricing as implied by CAPM but rather displays prevalence of herding (anti-herding). Coefficient γ_6 captures the change in the (anti-)herding coefficient after the adoption of MAD. If MAD was effective in reducing herding (anti-herding), we should observe positive (negative) values of γ_6, resulting in the post-MAD inefficiency ($\gamma_3 + \gamma_6$) being closer to zero than its pre-MAD counterpart (γ_3). We apply analogue procedures for TPD; $TPD_{t,j}$ is a dummy variable equal to 1 after TPD implementation in country *j* and 0 prior to that date, the coefficient of interest is γ_9 in model (3), which captures the incremental change in (anti-)herding after the adoption of TPD, compared to pre-TPD but post-MAD (anti-)herding levels.[11]

3.3. Descriptive statistics

that took place during the study window. We address these concerns by including time (both monthly and yearly, for robustness) and country fixed effects in the empirical identification of our models.

[9] Brambor et al. (2005) stress the necessity of including all the constituents of the multiplicative (interaction) term in the model to correctly estimate the change in the outcome variable (in this research, the herding coefficient).

[10] Given the staggered implementation of MAD and TPD, the values of these dummy variables can vary across countries *j* at the same timepoints, as these binary variables will turn from the value of 0 to 1 at different dates.

[11] The adoption of MAD precedes that of TPD for all countries in our sample. For example, in the UK, MAD entered into force in July 2005, whereas TPD did so in January 2007. See Table A1 in the appendix for all reforms dates.

Table 1 reports the descriptive statistics for daily market returns and cross-sectional absolute deviations (CSAD) for the 10 sampled countries. The mean daily market return ranges between -0.008% for Italy and 0.041% for Norway. The relatively high average return of Norway is accompanied by the highest volatility, represented by the standard deviation of returns of 1.314%. Moreover, the lowest daily market return is reported for the Netherlands (-9.064%) on 6 October 2008: on that day, the French bank AD-BNP-Paribas took control of the remaining assets of Fortis Bank, which had previously been taken over by the Dutch government. The highest daily market return was reported for Germany (10.668%) on 13 October 2008, this being part of the surge in world markets following the announcements of governments' bailout plans to mitigate consequences of the world financial crisis. First-order return autocorrelation is relatively low for all countries. Mean daily return dispersions range between 1.305 (in Spain) and 2.030 (in Norway). These descriptive statistics are similar in magnitude to the descriptive statistics reported in earlier studies (Chang et al., 2000; Chiang and Zheng, 2010; Economou et al., 2011). For CSAD, our data displays relatively high levels of first-order autocorrelation, exceeding 0.7 for all sampled countries: when estimating our models we account for this issue by estimating standard errors that are robust to heteroscedasticity and autocorrelation. Lastly, both variables show stationarity across all countries, as evidenced by the results of the Augmented Dickey-Fuller unit root test.

[Table 1 around here]

Values of CSAD are plotted against the market return for each country in Figure 1. We observe the typical cone-like structures as in prior studies (e.g., Chang et al., 2000; Gebka and Wohar, 2013); there is also an indication of the presence of outliers in our dataset. We account for the potential biasing effects of those outliers by excluding extreme residuals when estimating our empirical models. To that end, we apply the following procedure for each country: first, we estimate the standard CCK herding model (equation (2)) and extract its error terms. Then, similarly to previous studies (Menkhoff et al., 2006; Defond et al., 2011; Getz and Volkema, 2001) we identify and exclude observations pertaining to the 10 most extreme residuals.[12]

[Figure 1 around here]

3.4. Model specification and diagnostics

Given that our panel dataset consists of time series observations for 10 countries, it is very likely that standard errors of the regressions do not meet the assumptions of the standard OLS estimator. To ensure that we implement the most appropriate empirical specification which allows for robust inference, we run several diagnostic tests; Table 2 shows the results of these diagnostics. First, we test for the necessity of applying a country fixed or random effects model by applying the Hausman test. This technique, which compares the coefficient of random effects and fixed effects models, assumes that the random effect estimator is efficient. In order to test this assumption, we estimate a random effect model with and without clustering and compare the standard errors of each specification. We find that there is a major change in the magnitude of the standard errors of the estimated coefficients of model (3) after using country clustering. For instance, the herding coefficient (γ_3) and the coefficient of the change in herding following MAD and TPD (γ_6 and γ_9, respectively) become insignificant after applying country clustering. This is an indication that the random effect model is not an efficient model (Colin and Trivedi, 2009); thus, the standard Hausman test is not appropriate. We apply the cluster-robust Hausman test to decide between the fixed and random effect models. Table 2 shows that fixed effects model is more appropriate than the random effect model as the Wald test returns a p-value of 0.0025. Then, to compare the

[12] The cited studies rely on various methods of accounting for outliers, such as winsorizing the data (DeFond et al., 2011), removing countries with outliers from the sample (Getz and Volkema, 2001) or excluding outliers from the sample (Menkhoff et al.,2006). In this study, we exclude 5 most extreme negative 5 most extreme positive residuals. Estimating model (3) instead of (2) leads to the identification of the same outliers.

appropriateness of the random effect model versus a standard OLS model, we use the Breusch-Pagan LM tests of independence. The test reveals that the random effects model is superior to OLS (p-value = 0.000). This leads us to conclude that the fixed effect model is the most appropriate specification.

[Table 2 around here]

Given that our dataset has both time and country dimensions, our dependent variable may vary systematically across different years. Therefore, we test for the necessity of adding time fixed effects to the empirical specification. This requires testing the joint significance of time dummies in the regressions. Given that we utilize daily data, adding daily dummies would make the model intractable. Instead, we test the joint significance of monthly dummies. Results reveal evidence of the joint significance of those dummies (p-value of joint significance = 0.000).

Next, we move to diagnosing the characteristics of standard errors. Specifically, we test for the contemporaneous correlation of residuals using Breusch-Pagan LM test of independence and Pesaran's test of cross-sectional dependence. We find evidence in support of the presence of contemporaneous correlations between error terms (p-values of both tests are equal to zero: reject the null hypothesis of cross-sectional dependence). The modified Wald test for group-wise heteroscedasticity shows evidence in favour of the presence of heteroscedasticity (p-value = 0.000: reject the null hypothesis of homoscedasticity). Regarding the time series dimension of our data, the Woodridge test highlights the presence of autocorrelation (p-value = 0: reject the null hypothesis of no autocorrelation). However, there is no presence of unit roots in the panel dataset. We account for the presence of autocorrelation and heteroscedasticity by using Driscoll-Kraay standard errors when estimating our regressions.

4. Empirical results from baseline regressions

Estimation results for model (3) are presented in Table 3, column 1. In the pre-MAD subperiod, the return dispersion is significantly higher than what a rational asset pricing model dictates, as captured by a significant and positive value of γ_3. This indicates the prevalence of anti-herding, which could be due to overconfidence of investors or localised herding, whereby investors move into and out of subsets of stocks (e.g., as a result of style rotation strategy, following fads or (mis)information, attempting to mirror trading by perceived better-informed traders, or seeking refuge in safe-haven assets), thereby exerting excessive buying pressure on some stocks while exposing other stocks to abnormal selling pressures and consequently generating excessive price dispersion across the whole market (Gebka and Wohar, 2013). Overall, as the markets do not adhere to the CAPM-induced return dispersion pattern, it can be concluded that pre-MAD these markets suffered from an informational inefficiency.

[Table 3 around here]

The enactment of the MAD directive is further shown to have had a beneficial impact on the efficiency of EU stock markets: the negative and significant value of γ_6 indicates that the level of anti-herding declined substantially following MAD introduction, to the effect that the resulting post-MAD price behaviour appears to adhere to the rational asset pricing paradigm as encapsulated by CAPM; this is evidenced by the post-MAD level of herding/anti-herding, measured by $(\gamma_3 + \gamma_6)$, being close to zero and insignificant (p-value of 0.7326). Therefore, we can conclude that MAD appears to have achieved the aim of improving this particular dimension of market efficiency, by eradicating the prevalence of anti-herding.

Maybe not surprising in the light of the above, our estimation results further show that TPD has had no additional effects on how EU stock markets adhere to rational pricing principles as encapsulated by CAPM: the coefficient γ_9 is statistically insignificant.

The beneficial effect of MAD on market efficiency could be indicative of a number of phenomena induced by the implementation of this directive. For instance, if MAD was effective in limiting trading on insider information and therefore in reducing the risk of trading against a better-informed investor, this lower risk would have attracted more traders into the markets, boosting their liquidity and lowering transaction costs; under these conditions markets are to be expected to be more efficient. Similarly, MAD enactment could have also reduced market manipulation via trades or information dissemination, which would have boosted investors' confidence in both observed trades and asset prices, and in revealed information about companies. This would improve the quality of the overall information environment and lead to traders relying more on commonly observed market statistics (prices, volumes, etc) and news rather than individual (mis)perceptions, leading to reduction in excessive heterogeneity of valuations and trades. Lastly, MAD could also have worked as following informed investors' trades would have become less risky under reduced manipulation, hence prices would adjust more quickly to incorporate information and therefore the market would become more efficient.

The insignificant effect of TPD on stock market herding might indicate that the improved provision of information it was designed to cause was not a significant improvement vis-á-vis pre-TPD country-specific regulations for the TDP to have had an additional effect on markets, i.e., TPD might have been not needed (as our post-MAD results indicate market efficiency). In fact, Christensen et al. (2016) suggest that TPD did not impose new requirements, rather, it was mostly focused on improvements in implementation, enforcement and supervision. Our result of an insignificant TPD impact on the tendency of markets to herd/anti-herd suggests that this reform was either not required (as markets were efficient already) or the new TPD regime was not implemented by members states to a sufficient degree to have a significant market-wide effect. Lastly, TPD might have been effective in providing information to investors but those failed to act on it, for instance because of well documented underreactions to public news (Daniel et al., 1998, Odean, 1998, Chuang and Lee, 2006). We empirically explore these different alternatives later on in this study.

5. Robustness checks

In order to ensure the robustness of our findings, we perform a number of additional analyses: we test whether our results are driven by the world financial crisis, other directives and reforms, and diverse stock market conditions. The following section explains the rationale, procedures and results of those robustness checks.

5.1. Controlling for the 2007-9 global financial crisis

Periods of financial instability are characterized by biased investment decisions due to information asymmetry, fear, or volatility. For instance, there is evidence of an increased sentiment effect during the 2007-9 financial crisis (Bai, 2014). Such factors may affect our inferences on the consequences of MAD and TPD on stock market herding, however, the effect of financial crisis is rather unclear. From one perspective, it can be argued that due to uncertainty occupying markets and the low quality of disseminated information, investors will resort to mental shortcuts by mimicking the behaviour of other market participants; that is, investors will be involved in intensified herding. From an opposite perspective, periods of uncertainty can be accompanied by lower trading activity of individual investors who also tend to be more irrational than their institutional counterparts, leading to a reduction in the impact of irrational decisions on stock markets manifesting themselves as herding or anti-herding. Moreover, lower levels of liquidity in recessions are translated into higher trading costs, which also discourages investors from trading, including when that trading is mimicking other traders' investments. Hence, while the impact of the financial crisis on our results could be substantial, it cannot be determined on theoretical grounds alone due to these conflicting considerations. To investigate if our results are driven by the crisis rather than being representative of the overall sample period, we employ two approaches: (i) excluding markets which experienced a significant impact of the crisis on herding, and (ii) excluding the crisis period for all markets in the sample.

Firstly, in order to identify which market's herding coefficient was affected by the crisis, we run an auxiliary regression for each country separately: $\mathrm{CSAD_t} = \theta_1 + \theta_2|\mathrm{R_m}| + \theta_4(\mathrm{R_m})^2 + \theta_5|\mathrm{R_m}| * \mathrm{Crisis}_{\,t} + \theta_6(\mathrm{R_m})^2 * \mathrm{Crisis}_{\,t} + \epsilon_{\,t}$, where Crisis $_t$ is a dummy variable taking on the value of one during the crisis period (03/07/2007 - 15/05/2009, as empirically determined by Dungey et al., 2015) and zero otherwise. We observe (results not tabulated to conserve space) that Finland and Spain experienced a significant effect of the crisis on (anti-)herding (θ_6 is significant), hence we exclude those two markets from our panel and reestimate model (3) for the remaining eight countries.

The corresponding results are presented in Table 3, columns 2 and 3 for models estimated with monthly and annual time fixed effects, respectively. In both cases, these results are fully in line with our baseline result: pre-MAD, there was a significant deviation from rational asset pricing in form of excessive return dispersion in EU markets (anti-herding captured by a positive γ_3), the effect of MAD was beneficial to market rationality as it reduced the excessive return dispersion towards its rational level ($\gamma_6 < 0$ and significant), while the impact of TPD (γ_9) was insignificant. The difference to the baseline result in column 1 is that the post-MAD inefficiency seems to still prevail in the specification with annual FEs ($\gamma_3 + \gamma_6$ is positive and significant), which again poses a question of whether TPD was ineffective because it was not needed (if post-MAD inefficiency was eliminated completely) or because the reform was ineffective or not sufficiently enforced despite it being needed; we come back to this question later on in this study.

As an alternative test for the crisis impact on our baseline results, to isolate the effect of the financial crisis we exclude the crisis period from our analysis and re-estimate model (3) for the entire set of countries. Once again, both time-FE specifications (columns 4-5 in Table 3) confirm our baseline results: there was significant anti-herding prior to MAD, the MAD reform has had a significant impact on reducing this market inefficiency, while the subsequent TPS reform turned out to have had no further impact on return dispersion.

5.2. Controlling for concurrent reforms

The early years of the 21st century were characterized by intensive regulatory activity in Europe: the directives stemming from the FSAP and the Lamfalussy report, and the International Financial Reporting Standards (IFRS) introduced between 2002 and 2008. Here, we study the empirical consequences of MAD and TPD, given their conceptual relevance to market-wide phenomena such as efficiency and (anti-)herding. Other reforms, such as the Markets in Financial Instruments Directive (MiFID) which targets orders execution and the dissemination of shares trading information, and the IFRS and its compulsory implementation which aims at improving the quality of financial reporting, may also affect stock market (anti-)herding through the liquidity and transparency channels. To isolate the effects of these two reforms, we add their effects to model (3) as follows:

$$\begin{aligned} CSAD_t = {} & \gamma_1 + \gamma_2|Rm_{t,j}| + \gamma_3\left(Rm_{t,j}\right)^2 + \\ & +\gamma_4 MAD_{t,j}, + \gamma_5 MAD_{t,j} * |Rm_{t,j}| + \gamma_6 MAD_{t,j} * \left(Rm_{t,j}\right)^2 + \\ & +\gamma_7 TPD_{t,j} + \gamma_8 TPD_{t,j} * |Rm_{t,j}| + \gamma_9 TPD_{t,j} * \left(Rm_{t,j}\right)^2 + \\ & +\gamma_{10} IFRS_{t,j} + \gamma_{11} IFRS_{t,j} * |Rm_{t,j}| + \gamma_{12} IFRS_{t,j} * \left(Rm_{t,j}\right)^2 + \\ & +\gamma_{13} MiFID_{t,j} + \gamma_{14} MiFID_{t,j} * |Rm_{t,j}| + \gamma_{15} MiFID_{t,j} * \left(Rm_{t,j}\right)^2 + \varepsilon_t. \end{aligned} \tag{4}$$

MiFID is a dummy variable equal to one after MiFID is reported to be introduced in the particular country and zero otherwise (adoption dates follow Aghanya et al., 2020, and are reported in Table A1), the IFRS dummy assumes the value of one following the compulsory adoption across the EU starting in January 2006 (Christensen et al., 2016). The selected estimation results for model (4), both with monthly and annual time fixed effects, are presented in Table 3, columns 6 and 7, and yield full support to our baseline result: after controlling for the potential impact of MiFID and IFRS, we still find significant anti-herding pre-MAD, a significant efficiency-improving impact of MAD, and no effect attributable to TPD introduction. In the model with monthly time fixed effects, which possesses better fit to data and should be considered more reliable, we find no impact of IFRS but a significant impact of MiFID on the market (anti-herding).[13] In addition, we separate our sample into countries where TPD was implemented before MiFID and those where MiFID preceded TPD, and estimate model (4) for each of these subpanels separately. The results (columns 8-9 and 10-11, respectively) are fully in line with previous conclusions. Overall, we can conclude that those other reforms, MiFID and IFRS, did not drive our finding of the effectiveness of MAD and ineffectiveness of TPD.

5.3. Controlling for market states

It could be questioned whether the above *unconditional* findings of the effectiveness of MAD and the ineffectiveness of TPD in reducing stock market (anti-)herding hold universally regardless of the state the market is in, or whether they are conditional on market regimes such as rising vs. falling prices, high vs. low return volatility, or high vs. low trading activity. The rationale behind such an expectation of MAD and TPD effects being potentially *conditional* on market regimes is well grounded in the empirical literature on herding, as discussed in Section 2, where is has been widely established that the magnitude to which investors irrationally flock together can vary between, for instance, up and down markets, albeit with mixed results (e.g., Economou et al., 2015 report stronger herding in raising

[13] To conserve space, the MiFID and IFRS related coefficients are not reported but available from authors on request.

markets while Goodfellow et al., 2009, Holmes et al., 2013; Gavriilidis et al., 2013, observe that it is more intensive in falling markets.). In a similar vein, empirical evidence suggests that herding can differ between periods of high (Blasco et al., 2012;) vs low (Holmes et al., 2013;) volatility and high (Gavriilidis et al., 2013) vs. low (Economou et al., 2011) trading volume.

Therefore, differentiating among those market states can help us to uncover a more detailed picture of the impact of MAD and TPD on market efficiency. For instance, it could be that MAD-derived beneficial effects observed above are confined to only some but absent from or even detrimental in other market states (still resulting in the overall unconditional positive effect). Equally, it could be that the result of the overall unconditional ineffectiveness of TPD covers up significant effects of that reform observable only conditionally, i.e. present in specific market states but not in others, or TPD having counterbalancing effects on (anti-)herding across alternative market states such that in aggregate they add up to zero but are strongly positive/negative when considered within their respective regimes. Finally, it could also be that in one regime (e.g., up markets) the pre-reform inefficiency (e.g., anti-herding) is exacerbated, not reduced, following that reform's introduction, while at the same time in the alternative regime (e.g., down markets) an opposite inefficiency (herding) emerges; clearly, this would have made the market overall less efficient, but when considered in aggregate, i.e. without differentiating between different regimes, the overall result could be indicating no effect of the reform or even a beneficial impact (depending on which regime dominates). Overall, therefore, it is important to dissect the unconditional effects observed above into conditional, regime-specific ones, to shed light into the causes and patterns of the impact of these two reforms.

5.3.1. Up versus down markets

Given the baseline finding of excessive return dispersion pre-MAD as well as its elimination by that reform, we consider the following theoretical reasons as to why MAD could have affected the observed anti-herding differently in up vs down markets: overconfidence, insider trading, and flight to quality. On the one hand, overconfidence, which could have been the driving force behind the excessive return dispersions, is more likely to dominate investor behavior in up markets, as investors are attributing good performance of their portfolios to their skills, but not in down markets (Daniel et al., 1998, Gervais and Odean, 2001). Hence, if MAD was effective due to suppression of market manipulations and insider activities, therefore making information (news and observed market statistics) more credible and trading on it, rather than on irrational motives such as overconfidence, more prevalent, we would expect to observe anti-herding and subsequent MAD effectiveness in up rather than down markets. In addition, the presence of anti-herding could be driven by localized herding due to uninformed investors following insiders' trades into subsets of stocks. However, we expect insider trading to be less likely in falling markets: either because during falling markets there will be less room for profitable investments, such as mergers and acquisitions, on which trading would be profitable for insiders, or because during falling markets corporate insiders are under intensified scrutiny which make them less willing to engage in insider information-driven localized herding.[14] Hence, if MAD reduced insider trading, we would expect its effect to be more prevalent in up markets. On the other hand, flight to quality stocks would be more likely during descending market phases, hence, the observed anti-herding could be more pronounced in down markets if it was driven by investors jointly

[14] Huddart et al. (2007) find that insiders reduce their insider trades when they fear jeopardy which can take place formally through regulatory surveillance or informally through surveillance such as media, or lawsuits (see Dyke et al., 2010 on the sources of corporate fraud whistle blowing). There is also evidence that institutional shareholders are more likely to tolerate managerial misconduct in good times and that fraud is more likely to happen in booming markets, and stress the importance of regulations scrutiny during booming markets (Philippon 2006; Povel et al., 2007; Wang et al., 2010)

moving into a subset of stocks. Consequently, an improved information and insider-risk environment following MAD could have curbed the need of wholesale flight to quality, as investors should be able to better assess the quality of individual assets post-MAD rather than indiscriminatorily moving from one stock class/industry/style to another.

Overall, given these competing theoretical predictions, we investigate the impact of up versus down market movements on MAD and TPD effectiveness employing the following model:

$$
\begin{aligned}
CSAD_{i,t} = {} & \Upsilon_0 + \Upsilon_1 \left|R_{m,t}\right| * (1 - D_{up}) + \Upsilon_2 \left(R_{m,i,t}\right)^2 (1 - D_{up}) + \\
& + \Upsilon_3 \mathrm{MAD}_{i,t}(1 - D_{up}) + \Upsilon_4 \mathrm{MAD}_{i,t} * |R_{m,t}|(1 - D_{up}) + \Upsilon_5 \mathrm{MAD}_{i,t} * \left(R_{m,i,t}\right)^2 * \left(1 - D_{up}\right) + \\
& + \Upsilon_6 \mathrm{TPD}_{i,t} * (1 - D_{up}) + \Upsilon_7 \mathrm{TPD}_{i,t} * |R_{m,t}| * (1 - D_{up}) + \Upsilon_8 \mathrm{TPD}_{i,t} * \left(R_{m,i,t}\right)^2 * (1 - D_{up}) + \\
& + \Upsilon_9 \left|R_{m,t}\right| * \left(D_{up}\right) + \Upsilon_{10}\left(R_{m,i,t}\right)^2 * (D_{up}) + \\
& + \Upsilon_{11} \mathrm{MAD}_{i,t} * (D_{up}) + \Upsilon_{12} \mathrm{MAD}_{i,t} * |R_{m,t}| * (D_{up}) + \Upsilon_{13} \mathrm{MAD}_{i,t} * \left(R_{m,i,t}\right)^2 * \left(D_{up}\right) + \\
& + \Upsilon_{14} \mathrm{TPD}_{i,t} * (D_{up}) + \Upsilon_{15} \mathrm{TPD}_{i,t} * |R_{m,t}| * (D_{up}) + \Upsilon_{16} \mathrm{TPD}_{i,t} * \left(R_{m,i,t}\right)^2 * \left(D_{up}\right)^2 + \varepsilon_{i,t},
\end{aligned} \tag{5}
$$

where D_{up} is a dummy variable taking on the value of one when average market returns are positive on day t and zero otherwise. For down markets, Υ_2 represents the (anti-)herding coefficient pre-MAD, Υ_5 reflects the change in (anti-)herding after the adoption of MAD, and Υ_8 represents the subsequent impact of TPD. For up markets, the equivalent parameters are Υ_{10}, Υ_{13} and Υ_{16}.

Results in Table 4, Panel A show that excessive dispersions pre-MAD are significant in rising markets (Υ_{10}>0) and insignificant in falling markets (Υ_2). Similar to our baseline results, we find that MAD reduced the presence of anti-herding in rising markets, as represented by a negative and significant value of Υ_{13}. In the post-MAD period - that is, the period after the adoption of MAD but prior to the adoption of TPD - the presence of anti-herding in rising markets disappears, as represented by the insignificance of the sum of Υ_{10} and Υ_{13}. The adoption of TPD does not provide additional benefit over and above what was brought about by the adoption of MAD (Υ_{16} insignificant). It is noteworthy that in falling markets regimes, the absence of evidence of anti-herding is also followed by an insignificant effect of MAD: an indication that the effect of MAD is contingent on the presence of a form of market inefficiency that required regulatory treatment. Overall, the evidence shows that these reforms worked when they were needed, i.e. where there was prior inefficiency, and did not produce undesired efficiency-worsening results which could have been concealed in the unconditional baseline analysis. These results support the notion that pre-MAD anti-herding was caused by either investor overconfidence or mirroring insiders' trades, which diminished in magnitude following that reform.

5.3.2. High versus low market volatility

We follow the herding literature and also differentiate between market states of high vs. low volatility. Volatility can mirror arrivals of information (especially private information, see French and Roll, 1986) but can be also driven by irrational motives (Shiller, 1984), e.g. positively (negatively) by over- (under-) reactions to news (Barberis et al., 1998). Therefore, conditioning on volatility may be informative, but could also result in a plethora of contradicting expectations and empirical results, as evidenced in the herding studies reporting conflicting results on how volatility affects herding. However, it needs to be stressed that this a priori indeterminacy does not imply that there is no theoretical rationale for the expectation that our results could differ in high- vs. low-volatility regimes, only that the final empirical outcome will be an interplay of conflicting forces and is hence difficult to predict ex ante. For instance, if MAD worked due to reduction in insider trading risk and corresponding attraction of liquidity that boosted market efficiency, in periods of high volatility that risk-reduction could be less decisive and therefore the MAD effect less pronounced. However, MAD could have been successful through increasing reliability of available information (due to reduction in market manipulation via trades and mis-information): if high volatility is caused by information arrivals, post-MAD arrivals should be even more informative and useful to investors, hence resulting in more efficient markets (i.e. less anti-herding). If, however, high volatility is caused by irrational surges, the information environment would have been better in low-volatility subperiods, hence the effect of MAD should be observed primarily in those times.

To empirically investigate if, and how, both reforms affected market efficiency conditionally on the volatility of the market, we re-estimate model (5), replacing the market movement dummy D_{up} with an equivalent high-volatility dummy, which is equal to one if volatility is higher than its thirty-day moving average and zero otherwise (Cui et al., 2019; Economou et al., 2011; Guney et al., 2017). We follow the approach of Cui et al. (2019) and proxy for market volatility by the squared value of daily market returns (Rm^2). The results reported in Table 4, Panel B show that our baseline finding of the effectiveness of MAD holds in both volatility regimes. Hence, MAD worked where it was needed (pre-MAD inefficiency), leading to an elimination of anti-herding. For TPD, we do observe a significant increase in anti-herding for low volatility subsample, implying that TPD partially re-introduced inefficiency (excessive return dispersion). A potential explanation for that detrimental TPD effect could be that its effects, i.e. qualitative and quantitative improvements in information provision, could overwhelm boundedly-rational investors (Simon, 1957) and lead them to be confused and/or to ignore part of this information, instead relying on mental shortcuts such as following the trades of others into subsets of stocks. Additionally, if traders ignore different parts of the information set, their trading would diverge leading to an excessive dispersion of stock prices (see literature on irrational behavior, e.g., Eyster et al., 2019; Corona and Wu 2019, and rational inattention models, e.g., Veldkamp, 2011; Kacperczyk et al., 2016; Myatt and Wallace, 2012; Blankespoor et al.,2020).

5.3.3. High versus low trading volume

Lastly, we investigate the effect of MAD and TPD during periods of high vs. low trading volume, which could reveal whether the effectiveness of these reforms is contingent on trading levels and potentially yield deeper insights into what drives anti-herding and why those reforms were, or were not, effective in boosting market efficiency. On the one hand, trading volume has been linked to confidence, both at the individual level, where studies have found that investors who are overconfident tend to trade more (Barber and Odean, 2001, Odean 1998), and on the aggregate level, highlighted by the significant positive correlation between trading volume and overconfidence (Statman et al., 2006; Kim and Nofsinger, 2003). Given that anti-herding can arise due to overconfidence, and since high volume reflects investor overconfidence, a favorable MAD effect (reduction in anti-herding) that is contingent on high trading volume can be an indication that MAD operates via the market overconfidence channel. On the other hand, low trading volume implies low liquidity and/or low rates of information arrivals: in the former case, insider trades and market manipulation would be expected to have larger impact on prices, leading to increased return dispersion, phenomena which MAD was aimed to curb; in the latter case, information-deprived traders could be turning to noise as the driver of their decisions, again leading to inefficient outcomes (e.g. anti-herding), an issue which MAD-induced improvements in information quality would address. Overall, there are several reasons as to why return behaviour and reform impact could differ in high vs. low volume regimes but the net outcome cannot be determined on theoretical grounds, hence we conduct an empirical investigation of this aspect.

To reveal the effect of MAD and TPD in high and low trading volume regimes we estimate model (5), replacing the market movement dummy D_{up} with an equivalent high-volume dummy, which is equal to one if volume is higher than its thirty-day moving average and zero otherwise (Cui et al., 2019; Economou et al., 2011; Guney et al., 2017), where volume is defined as the number of shares traded on day t. The results, reported in Table 4, Panel C, firstly reveal that high-volume subperiod does not show any evidence of excessive return dispersion and no impact of either MAD or TDP on herding/(anti-)herding among investors. However, when we turn to low-volume days, the results are fully in line with the baseline findings: the significant initial anti-herding was fully eliminated by the introduction of MAD, and the subsequent TPD enactment did not have any further effect on this manifestation of stock markets' efficiency. These results indicate that high market liquidity is equivalent to high levels of informational efficiency, but during less liquid times with scarce information provision markets tend to display evidence of inefficiency, this however appears to have been rectified in our sample by the MAD directive which aimed at reducing insider trading risk and market manipulative practices.

Looking across all three market conditioning variables (market direction, volatility, and volume), these results strongly support our inference from unconditional analysis: There was excessive return dispersion pre-MAD (in down markets, low volume regimens, and independent from volatility levels) which MAD introduction eliminated. The subsequent TPD reform has had very little to no effect (except in the low volatility regime where it appears to have worsened market efficiency slightly by re-enabling anti-herding).

6. Explaining the results

In this section, we further attempt to empirically unveil why MAD introduction appears to have improved stock market efficiency in the EU whereas the subsequent TPD reform did not have any significant effect on those markets. For each of the hypotheses below, we divide the sample of countries, along one dimension at a time, into two equal groups, e.g. countries with high and low stock market liquidity, relatively to the cross-country median liquidity, and estimate model (3) for each of those two groups separately (details on those dividing variables used in this section are reported in Table A2 in the appendix).

6.1. Why was MAD effective?

One potential channel through which MAD could have worked was by reducing the risk of trading against insiders, hence attracting more trades from risk-averse investors, making the market more liquid overall, which in turn boosted its efficiency. Therefore, one would expect the MAD effect to be more pronounced in less liquid countries pre-MAD, as these would have benefited more from the MAD-induced liquidity boost. Indeed, when we divide our panel into groups of high vs. low Amihud illiquidity ratios, the pre-MAD inefficiency and its elimination by the MAD reform are only observed in the high-illiquidity subgroup (Table 5, Panel A). This result points towards a liquidity-boosting insider risk reduction as a channel through which MAD improved the efficiency of EU stock markets.

[Table 5 around here]

Another potential channel for MAD effectiveness is the limitation on manipulative trades and information dissemination, which would make observed trades and news more credible and induce investors to rely more on those signals, hence their judgements and trades becoming less driven by irrational motives and transaction prices better reflecting fundamental values of assets. If MAD worked via this channel, one would expect a more pronounced effect in countries where the information environment was weaker pre-MAD, hence traders' decisions being more prone to be affected by non-rational drivers. As for the information environment argument, we empirically capture it by dividing our sample into countries with high vs. low post-earnings announcement drift (PEAD) effect, as PEAD has been attributed in prior literature to poor information availability and endowment of investors (Hung et al, 2015). In line with this hypothesis, we observe (Table 5, Panel B) that only countries with a strong PEAD effect experienced an excessive return dispersion pre-MAD, which was eliminated as MAD was enacted. Hence, this result is in line with the reasoning that MAD reduced market inefficiency because MAD engineered a boost in information credibility, which was subsequently utilized by traders to make more rational decisions. Another approach to investigate the information-improvement hypothesis of MAD effectiveness is to analyse if countries which have had other well enforced reforms which aimed at information provision to investors benefited from MAD to the same extent as those countries where other similar reforms were not well enforced and, hence, where the availability of high quality information was poorer. To this end, we divide our sample into countries with high vs. low levels of enforcement of the IFRS and expect the former to have needed the MAD less than the latter. Indeed, we find an indication of this effect empirically (Table 5, Panel C): the pre-MAD inefficiency and the subsequent improvement are significant only for countries with low levels of IFRS enforcement, while high-enforcers did not record a significant excessive return dispersion pre-MAD. However, the differences between those two groups are not statistically significant.

To further explore if MAD could have worked by providing high quality information for rational decision making, especially in countries where irrational motives to trade were most pronounced pre-MAD, we consider two cultural characteristics affecting individual decisions, individualism and indulgence (Hofstede Insights, 2021).

Previous studies on overconfidence linked its presence to individualism. Countries with high level of individualism are characterized by emphasize on personal capabilities, when compared to less individualistic (i.e. more collectivistic) countries. Moreover, in countries with higher level of individualism, individuals tend to display more confidence in their abilities relative to their peers and in their predictions of future outcomes (Van den Steen 2004; Heine et al., 1999; Markus and Kitayama, 1991). We adopt Hoftstede's individualism data as a measure of country-level overconfidence to investigate whether it contributes to market inefficiency (anti-herding), i.e., we test whether overconfidence was causing excessive return dispersion pre-MAD and whether the effect of MAD (of reducing this excess dispersion) worked through the overconfidence channel. If this was true, we would expect countries with relatively higher levels of individualism to display more pronounced anti-herding pre-MAD and to witness a significant MAD effect in reducing or eliminating this inefficiency. To this end, we group the sampled countries by their score on Hofstede's individualism measure, where countries with above-median individualism scores belong to the high-individualism group and countries with below-median scores belong to the low-individualism group, and estimate model (3) for each group separately. Results in Table 5, Panel D shows that anti-herding is only evident in high-individualism countries, supporting our hypothesis that anti-herding was induced by overconfidence of investors. Furthermore, MAD introduction significantly eliminated that pre-reform inefficiency, in support of our hypothesized channel that MAD-induced improvements in information reliability boosted the fraction of trades relying on facts rather than irrational motives (such as overconfidence). The differences in relevant coefficients between high- and low-individualism countries are also significant.

Another potential dimension of irrationality we analyze is indulgence, defined as the allowance of individuals to freely enjoy personal gratification. In a restrained society - a society with low indulgence - individuals are expected to suppress personal gratification in accordance with social norms (Hofstede, 2021). Based on this definition, in countries with relatively low indulgence levels one would expect individuals to have more self-control over the urge to act irrationally. Accordingly, we would expect stronger market irrationality (anti-herding as documented above) to be more prevalent in countries with relatively higher levels of indulgence. Moreover, the effect of MAD in reducing the presence of anti-herding is expected to be more pronounced in those countries, as MAD aimed at making observed trades and information announcements more indicative of firms' fundamental values, hence facilitating trading on fundamental information rather than irrational motives. Panel E of

Table 5 shows that, in line with those expectations, anti-herding is only evident in European countries with higher levels of indulgence. Also, the effect of MAD adoption in reducing herding is only significant in these countries, to the effect that anti-herding has been eliminated after the adoption of MAD. Therefore, the empirical evidence supports the notion that MAD worked because it made trading on rational (irrational), information-driven (emotions-driven) motives more (less) feasible and therefore more prevalent (sporadic).

The aforementioned phenomena could be additionally manifesting themselves in a particular way, namely, an irrationally excessive return dispersion could be brought about by a fraction of traders moving into and out of certain stocks in unison, i.e., due to localized herding (Gebka and Wohar, 2013). This could be driven by their (joint within a subgroup of investors) overconfidence about those specific stocks/industries/investment styles, or by following knowledgeable traders (e.g., insiders or more sophisticated institutional traders). Hence, it would be more pronounced in less liquid environments, as buying/selling pressure would cause temporal deviation of prices from their fundamental values, resulting in an excessive return dispersion across the whole market. Indeed, the results for illiquidity-separated subsamples (Panel A) support this notion of prevalence of localized herding pre-MAD and its curtailment by MAD, as only illiquid markets exhibit excess dispersion of returns in line with this argument.

Overall, our results indicate that MAD reduced market inefficiency, which manifested itself as anti-herding, because it i) boosted market liquidity by reducing the risk of trading against better-informed insiders, and ii) made trading on fundamental information more prevalent by improving information credibility via limiting market manipulations through deceptive trades and misinformation dissemination.

6.2. Why was TPD not effective?

Our baseline results and the accompanying robustness checks reported above showed that TPD had virtually no effect on the form of market efficiency we study (herding/anti-herding). This could be hypothetically due to one of the following effects: (i) either TPD was needed and sufficiently enforced but markets' reactions to better publicly available information it brought about were too sluggish to affect their efficiency, (ii) TPD was needed but has not been sufficiently enforced,[15] or (iii) TPD was not needed at the time it was introduced. We consider each of these potential explanations in turn below.

To investigate empirically if TPD could have been needed and enforced but, in environments with sluggish information utilization, did not prove effective, we compare countries with high vs. low PEAD levels (Panel B). As high levels of PEAD signify underreactions to news, we would expect low-PEAD countries to have a stronger capacity to utilize additional information generated by TPD introduction and therefore a stronger TPD effect. The results show that TPS introduction had no significant effect regardless of the level of PEAD, with the difference in TPD coefficients between these two groups being insignificant as well, hence we do not find support for the notion that underreactions to information explain the observed ineffectiveness of TPD.

Having ruled out one possible explanation for the ineffectiveness of TPD, we now investigate if the reason for this result was that some countries would have benefited from it but their enforcement levels were insufficient. If we turn to IFRS enforcement results (Table 5, Panel C) as a proxy for overall rules enforcement level, the TPD effect is insignificant for both high- and low-enforcers, and insignificantly different across those two groups, rejecting the above-mentioned hypothesis. In addition, when we divide our sample into countries with high vs. low rule-of-law scores as an alternative proxy for rules enforcement, we obtain a

[15] See, e.g., Christensen et al., 2013, Daske et al., 2013, Florou and Kosi 2015, and Hung et al., 2015, on the importance of enforcement to achieve desired benefits of capital market reforms.

qualitatively identical result (Panel F): there is no TPD impact in either high- or low-scoring countries, with this effect not being significantly different between these two groups either. Hence, we conclude that there is no sufficient evidence that lack of TPD effectiveness was due to its poor enforcement in some countries.

Lastly, we investigate the remaining potential explanation for TPD ineffectiveness, namely that was just not needed, at least in terms of reducing the inefficiency form as analyzed here, following the success of MAD as documented above across a plethora of robustness tests. As an additional piece of analysis, we hypothesize that if TPD was needed, its effect would have been more pronounced in countries with prior poor information availability, as TPD was aimed at improving availability of information to investors. To this end, we divide our sample into countries with high vs. low levels of analyst coverage (based on the number of analysts following stocks reported in Griffin et al., 2010) as a proxy for information availability to company outsiders. The results (Table 5, Panel G) show that TPD has had no significant effect on either of these groups, and the TPD coefficient was not significantly different between high vs. low analyst coverage markets, either. Therefore, our results support the notion that TPD was not required at the time when it was introduced, as the preceding MAD reform effectively completely eliminated the form of market inefficiency, anti-herding, observed in the early part of our sample time.

Lastly, it is worth noting that the results in Table 5 further support our previous findings and conclusions: there was a significant amount of anti-herding pre-MAD (under certain conditions), the MAD reform eliminated this form of market inefficiency (where it was present before), and the TPD reform has had no further impact on the efficiency of EU stock markets, at least when efficiency is measured by the magnitude of excess return dispersion on those markets.

7. Summary and conclusions

We empirically analyse the consequences of two major EU directives, MAD and TPD, for what was one of their explicit ultimate goals, i.e. the improvement of informational efficiency of the pan-EU capital market. Our results robustly indicate that the stock market was not efficient prior to MAD introduction, as it was displaying irrationally high levels of stock return dispersion. However, the enactment of MAD is demonstrated to have eliminated this market inefficiency, to the extent that the subsequent TPD reform has have no additional effect on stock market efficiency in the EU. Further analysis shows that these patterns were primarily observed in down markets, low volume regimes, and were independent from volatility levels. We find that pre-MAD inefficiency, manifesting itself as anti-herding, was related to investor overconfidence, low self-control, and tendency to engage in localized herding; MAD-induced improvements in the form of reduced risk of trading against insiders and higher informational content of trades boosted the markets' liquidity and reliance on information rather than irrational motives, hence improving the overall market efficiency. On the other hand, TPD is shown to had been ineffective, not because its implementation was insufficient or investors' reactions to additional information sluggish, but because it was not needed following the beneficial effects of MAD on market efficiency.

Our study contributes to the still very limited body of research in accounting and finance on the stock market consequences of MAD and TPD, empirically demonstrating the beneficial effect of the former and redundancy, in the context of our measure of market inefficiency, of the latter. These results feed into the broader discussion of the necessity of evidence-based policy (Leuz, 2018) as they provide the necessary evidence for EU policy makers to re-evaluate the effectiveness of those reforms, and to decision makers outside the EU where similar regulatory measure may be under consideration. We also contribute to the insider trading literature where the question of profitability of insider trading has been widely discussed, with contradictory results even in the context of the MAD directive (e.g., Christensen et al., 2016, vs. Gebka et al., 2017). In addition, our results constitute novel contributions to the herding literature, as we (i) document that anti-herding is much more prevalent than herding in certain markets, and (ii) highlight that substantial changes to the regulatory environment, in addition to other significant events such as financial crisis, may have an effect on investor (anti-)herding and should therefore be considered in future research on herding. Lastly, our contribution to the accounting and finance literature is to bring into prominence the observation that decisions are driven by both rational and irrational motives, hence both these strands, and interactions between them, should be considered when analyzing financial decision-making processes and their behavioural consequences.

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Appendix

Table A1: Implementation dates of financial reforms

Reform/Country	MAD	TPD	MiFID	IFRS
Belgium	Sep-05	Sep-08	Nov-07	Jan-06
Denmark	Apr-05	Jun-07	Nov-07	Jan-06
Finland	Jul-05	Feb-07	Nov-07	Jan-06
France	Jul-05	Dec-07	Nov-07	Jan-06
Germany	Oct-04	Jan-07	Nov-07	Jan-06
Italy	May-05	Apr-09	Nov-07	Jan-06
The Netherlands	Oct-05	Jan-09	Nov-07	Jan-06
Norway	Sep-05	Jan-08	Nov-07	Jan-06
Spain	Nov-05	Dec-07	Feb-08	Jan-06
United Kingdom	Jul-05	Jan-07	Nov-07	Jan-06

Note: Dates on MAD, TPD and IFRS are from Christensen et al. (2016), dates on MiFID are from Aghanya et al. (2020).

Table A2: Description of sample-dividing variables

Variable name	Definition	Source of data
Amihud's Illiquidity Ratio	Defined as the absolute value of stock market returns divided by the volume in currency unit	Datastream
PEAD	Defined as the positive relationship between current surprises in earnings' announcements and subsequent stock returns	Hung et al 2015
IFRS Enforcement	Reflects whether a country has implemented substantive enforcement procedures support the adoption of IFRS	Christensen el at., 2013)
Individualism versus collectivism	Individualism reflects the degree to which a society emphasizes the individuals' interests. On the other end, collectivism describes the tendency of societies to prioritize the interest of the group over the interests of individuals.	Hofstede Insights webpage: https://hi.hofstede-insights.com/national-culture
Indulgence versus restraint	Indulgence reflects societies' tendencies to acknowledge natural drives to enjoy life. Restraint reflects the societies' tendencies to suppress natural drives and restrain them within social norms.	Hofstede Insights webpage: https://hi.hofstede-insights.com/national-culture
Rule of Law	Reflects citizens' perceptions of the effectiveness of policies implemented to enforce and protect property rights, and the functioning of the court and police institutions, and expectations on the likelihood of crime and violence	Worldwide Governance Indicators (WGI)-The World Bank
Analyst Coverage	Defined as the percentage of firms with analyst coverage	Griffin et al. (2010)

Figure 1: Cross-sectional return dispersion (CSAD) as a function of market returns.

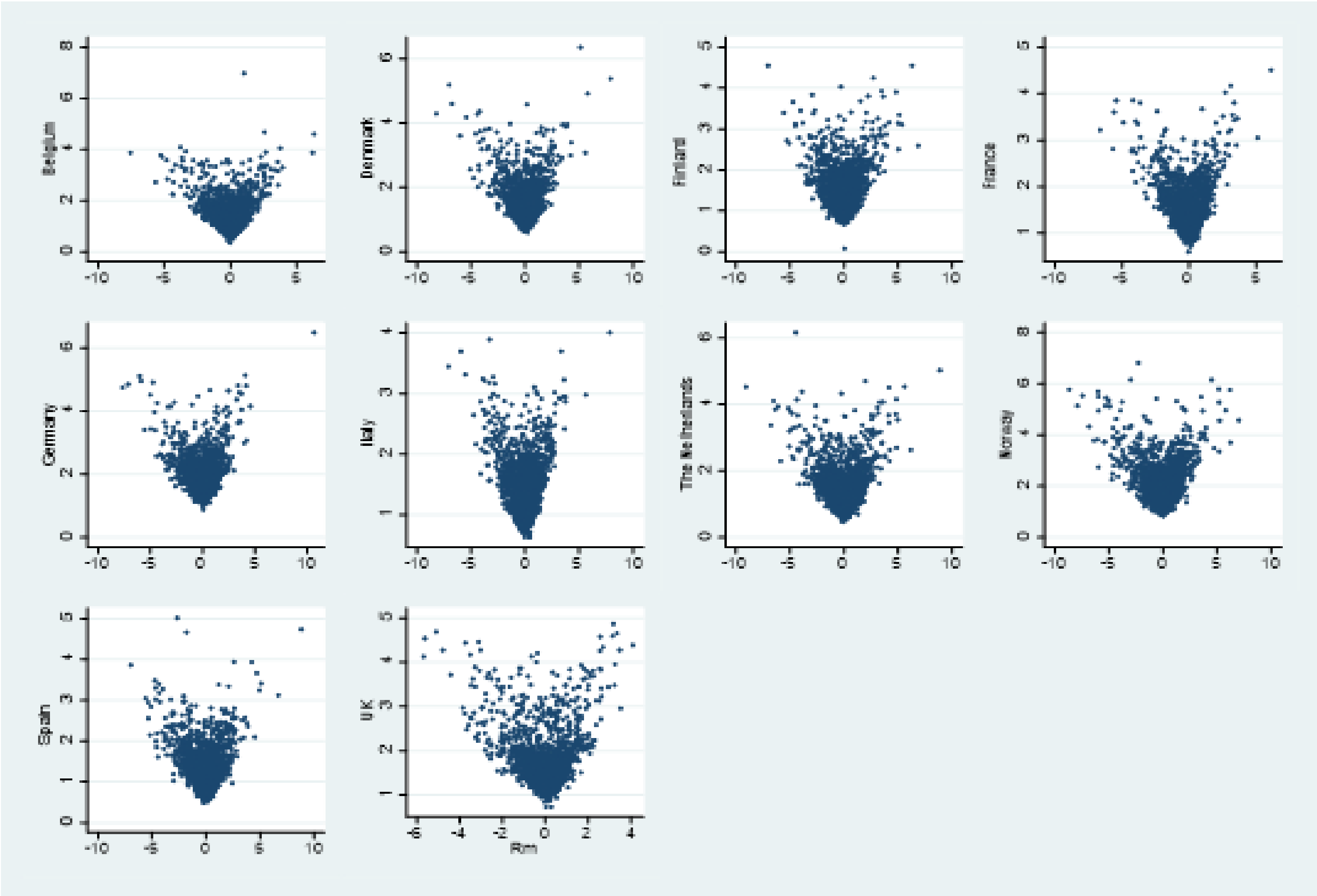

Table 1: Descriptive statistics

	Obs.	Mean (%)	S.D (%)	Max.(%)	Min. (%)	Serial autocorrelation at lag					ADF	Skewness	Kurtosis
						1	2	3	5	20			
Belgium													
CSAD	2,308	1.321	0.565	6.971	0.349	0.748	0.721	0.698	0.667	0.57	0	2.259	11.638
R_m	2,308	0.018	0.917	6.30308	-7.5595	0.181	0.096	-0.00 -	0.01	0.002	0	-0.849	11.588
Denmark													
CSAD	2,258	1.491	0.559	6.36	0.605903	0.763	0.728	0.688	0.657	0.508	0	2.271	11.668
R_m	2,258	0.024	1.014	7.901	-8.209089	0.185	0.119	0.018	0	0.02	0	-0.87	12.628
Finland													
CSAD	2,267	1.46	0.494	4.549	0.0822701	0.66	0.638	0.593	0.577	0.456	0	1.685	7.456
R_m	2,267	0.032	1.104	6.855	-7.035883	0.127	0.085	0	-0.03	-0.01	0	-0.187	7.681
France													
CSAD	2,308	1.476	0.465	4.508	0.5965	0.765	0.747	0.723	0.69	0.58	0	1.799	7.617
R_m	2,308	0.021	0.925	6.122	-6.624028	0.186	0.109	0.025	0.012	0.038	0	-0.99	9.755
Germany													
CSAD	2,295	1.864	0.5654	6.487	0.873	0.783	0.758	0.733	0.7	0.58	0	2.075	10.046
R_m	2,295	0.038	1.066	10.668	-7.629	0.181	0.09	0.020 -	0.01	0.027	0	-0.58	12.517
Italy													
CSAD	2,290	1.347	0.442	4.009	0.629	0.843	0.815	0.785	0.75	0.599	0	1.658	6.741
R_m	2,290	-0.008	1.031	7.842	-7.097	0.128	0.089	0.007 -	0.01	-0.01	0	-0.647	8.5
Netherlands													
CSAD	2,308	1.3921	0.602	6.171	0.467	0.747	0.714	0.702	0.68	0.583	0	2.093	9.502
R_m	2,308	0.023	1.205	8.859	-9.064	0.107	0.072	0	0.03	0.015	0	-0.603	9.63
Norway													
CSAD	2,265	2.03	0.743	6.815	0.829	0.693	0.657	0.637	0.619	0.521	0	1.77	7.912
R_m	2,265	0.041	1.314	7.006	-8.665	0.122	0.094	0.000 -	0	-0.01	0	-0.91	8.698
Spain													
CSAD	2,285	1.305	0.481	5.016	0.486	0.72	0.677	0.653	0.613	0.515	0	1.802	9.212
R_m	2,285	0.007	1.141	8.825	-6.969	0.095	0.029	0.001 -	0	-0.02	0	-0.516	8.424
UK													
CSAD	2,275	1.676	0.596	4.864	0.728	0.865	0.831	0.822	0.804	0.735	0.006	1.2	7.775
R_m	2,275	0.033	0.896	4.098	-5.69	0.215	0.107	0.053	0.042	0.023	0	-0.981	7.925

Note: CSAD stands for the cross-sectional absolute deviation of daily stock returns while R_m stands for the daily market return. Obs. Denotes the number of observations for a country, S.D. denotes standard deviation of daily returns, while Min and Max stand for the lowest and highest daily return in the sample period. ADF denotes the p-value of the augmented Dickey-Fuller unit root test statistic.

Table 2: Diagnostic tests

Test	Result
Breusch-Pagan LM test for random effects (Breusch and Pagan, 1980)	Random effects model is preferred over an OLS pooled model: chibar2(01) = 1.1e+06, p-value=0.000, reject the null hypothesis that variances across countries are zero (i.e. that there are no panel effects).
(Country-) fixed versus random effects: Robust Hausman test (Hausman, 1978)	Fixed and random effects significant: Chi-sq(7) 955.879, p-value = 0.000: reject the null hypothesis that the preferred model is RE; opt for the alternative of country FE.
A test for the existence of time fixed effects: Tests whether monthly time dummies are jointly significant; under the null hypothesis all dummies are jointly equal to zero.	Time effects are significant: P-value = 0.0000: reject the null hypothesis of no joint significance of time dummies.
Cross-sectional dependence of residuals using: • Breusch-Pagan LM test of independence (Breusch and Pagan, 1980) • Pesaran's test of cross-sectional independence (Pesaran, 2004)	Presence of cross-sectional dependence: Breusch Pagan (1980): chi2(45) = 15844.613, p-value = 0.0000. Pesaran's test of cross-sectional independence: CD = 120.573, p-value = 0.0000. Reject the null hypothesis of no cross-sectional dependence.
Heteroskedasticity: Modified Wald test for groupwise heteroscedasticity in fixed effect regression models (Green, 2012)	Presence of heteroscedasticity: Chi2 (10) = 361.64, p-value = 0.0000: reject the null of homoscedasticity
Autocorrelation: Wooldridge test for autocorrelation in panel data: Wooldridge (2002)	Presence of autocorrelation: F(1, 9) = 152.408: p-value = 0.0000: reject the null hypothesis of no first-order autocorrelation.
Stationarity: Fisher-type unit-root test based on augmented Dickey-Fuller tests	Evidence of stationarity of CSAD: • Inverse chi-square: 189.7559; p-value: 0.0000 • inverse normal: -11.8318: p-value: 0.0000 • inverse logit: -16.6977: p-value: 0.0000 • modified inv. Chi-squared: 26.8408: p-value: 0.0000 We reject the null hypothesis of a unit root in CSAD Evidence of stationarity of |Rm|: • Inverse chi-square: 432.5072, p-value: 0.0000 • inverse normal: -19.4009, p-value: 0.0000 • inverse logit: --38.0636 p-value: 0.0000 • modified inv. Chi-squared: 65.2231, p-value: 0.0000 We reject the null hypothesis of a unit root in |Rm| Evidence of stationarity of Rm2: • Inverse chi-square: 520.6211., p-value: 0.0000 • inverse normal: -21.4119, p-value: 0.0000 • inverse logit: -45.8183 p-value: 0.0000 • modified inv. Chi-squared: 79.1552, p-value: 0.0000 We reject the null hypothesis of a unit root in Rm2.

Table 3: Baseline empirical results (models (3) and (4))

Variables	Coefficient	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\lvert R_m \rvert$	γ_2	.287227 ***	.3091298	.3691368***	.3085918***	.3599316***	0.287***	0.341***	.2998156***	0.327***	0.277***	0.351***
		(0.0000)	0.000	0.000	(0.0000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	0.000)	(0.000)
Rm^2	γ_3	.0602753 ***	.0494496**	.0518509**	.0447937 **	.0469141 **	0.0602***	0.0613***	.0549354**	0.0606**	0.0615**	0.0598**
		(0.0050)	0.020	0.015	(0.014)	(0.023)	(0.005)	(0.005)	(0.040)	(0.028)	(0.017)	(0.025)
MAD	γ_4	.0503168 ***	.0728406***	.0319886	.0432583**	.0201157	.0219	0.0012	.0580788**	-.0210344	0.0149	0.00488
		(0.007)	0.000	0.058	(0.030)	(0.210)	(0.366)	(0.954)	(0.029)	(0.463)	(0.663)	(0.881)
$\lvert R_m \rvert$*MAD	γ_5	-.0408614	-.069814 *	-.0735626 *	-.0565038*	-.0774982**	.04000	0.015	.085443	.0829386	0.0830	0.0564
		(0.284)	(0.083)	(0.081)	(0.082)	(0.026)	(0.455)	(0.778)	(0.105)	(0.162)	(0.336)	(0.538)
Rm^2*MAD	γ_6	-.0592028***	-.0478571 **	-.0400547 *	-.035518*	-.0364149*	-0.0726***	-0.0759***	-.130698***	-.134121***	-0.0769**	-0.0820**
		(0.007)	(0.026)	(0.066)	(0.060)	(0.086)	(0.007)	(0.005)	(0.000)	(0.000)	(0.021)	(0.019)
TPD	γ_7	.0123112	-.0006071	-.0056593	.0211495	-.0113974	-0.0070	0.0172	.0049291	.0573273	-0.0615**	-0.0138
		(0.430)	(0.972)	(0.822)	(0.288)	(0.585)	(0.683)	(0.523)	(0.899)	(0.116)	(0.033)	(0.797)
$\lvert R_m \rvert$**TPD*	γ_8	.0232382	.0544382 ***	.0986174***	.0154254	.0446263**	0.0468**	0.0344	-.067886**	-.0221458	0.0880***	0.0609
		(0.137)	(0.002)	(0.000)	(0.440)	(0.033)	(0.038)	(0.239)	(0.059)	(0.553)	(0.001)	(0.157)
Rm^2*TPD	γ_9	.0041131	.0022955	-.0030518	-.0075007	-.0085318	0.00268	0.00244	.0139083	-.003344	-0.00308	-0.00217
		(0.271)	(0.564)	(0.499)	(0.202)	(0.172)	(0.524)	(0.634)	(0.185)	(0.756)	(0.557)	(0.772)
Constant	γ_1	1.538004***	1.590239 ***	1.463198***	1.537752**	1.401565***	1.537***	1.405***	1.623296***	1.492864***	1.485***	1.349***
		(0.000)	(0.000)	(0.000)	(0.0000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	$\gamma_3+\gamma_6$	0.0010725	0.0015925	0.0117962**	0.0092757*	0.0104992**	-0.0124	-0.0146	-0.0757626***	-0.073521***	-0.0154	-0.0222
		(0.7326)	(0.6228	(0.0032)	(0.0525)	(0.0190)	(0.4351)	(0.3641)	(0.0000)	(0.0000)	(0.4660)	(0.3273)
Time fixed effects		Monthly	Monthly	Yearly	Monthly	Yearly	Monthly	Yearly	Monthly	Yearly	Monthly	Yearly
Country fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared		0.7703	0.751	0.6182	0.5821	0.5035	0.7312	0.6063	0.7416	0.6089	0.7332	0.6094
Observations		22,849	18297	18297	18139	18139	22,849	22,849	9,085	9,086	13,754	13,754
Number of countries		10	8	8	10	10	10	10	4	4	6	6

Note: This table presents estimation results for model (3) unless stated otherwise. Colum (1) shows the results for the full sample baseline case. Columns (2)-(3) report results for those countries only where the herding coefficient was not affected by the global financial crisis, while columns (4)-(5) report resuls from estimations where the global financial crisis period was excluded for all 10 countries in the panel. Columns (6)-(7) report selected results from model (4) where the effects of MiFID and IFRS are controlled for in the full panel. The same model (4) is estimated for subpanels: for countries where TPD preceded MiFID (columns (8)-(9)) and where MiFID preceded TPD (columns (10)-(11)).***, **, * denotes significance at 1%, 5%, 10% level, respectively..

Table 4: The effects of MAD and TPD conditional on market states

Effect:	Pre-MAD	MAD	Post-MAD	TPD	Adj. R^2	No of obs.
Panel A: Down versus up markets						
	Y_2	Y_5	$Y_2 + Y_5$	Y_8		
Down market	.0496381	-.0426709	0.0069672*	.0017237		
	(0.187)	(0.260)	*(0.0985)*	(0.716)		
					0.7362	22849
	Y_{10}	Y_{13}	$Y_{10} + Y_{13}$	Y_{16}		
Up market	.0849707***	-.0861629 ***	-0.0011922	.0054334		
	(0.000)	(0.000)	(0.7802)	(0.292)		
Panel B: Low versus high market volatility						
	Y_2	Y_5	$Y_2 + Y_5$	Y_8		
Low volatility	0.087441 ***	-.0914801***	-0.0040391	.0490258 **		
	(0.001)	(0.005)	(0.8367)	(0.020)		
					0.7316	22849
	Y_{10}	Y_{13}	$Y_{10} + Y_{13}$	Y_{16}		
High volatility	.0595994 **	-.0625171**	-0.0029177	-.0010198		
	(0.015)	(0.012)	(0.4696)	(0.836)		
Panel C: Low versus high market trading volume						
	Y_2	Y_5	$Y_2 + Y_5$	Y_8		
Low volume	0.0956***	-0.0889***	0.0067	0.0134		
	(0.000)	(0.0000)	(0.4468)	(0.231)		
					0.7355	22849
	Y_{10}	Y_{13}	$Y_{10} + Y_{13}$	Y_{16}		
High volume	0.0423	-0.0412	0.0011	0.00316		
	(0.100)	(0.112)	(0.7328)	(0.410)		

Note: This table presents estimation results for model (5). ***, **, * denotes significance at 1%, 5%, 10% level, respectively.

Table 5: The effects of MAD and TPD conditional on country characteristics

	Pre-MAD	MAD	Post-MAD	TPD	R^2	Nos
	Y_3	Y_6	Y_3+Y_6	Y_9		
Panel A: Amihud's illiquidity ratio						
Low	.0020877	.0057024	0.0077901	-.0051493	0.5987	11,381
	(0.943)	(0.849)	(0.1827)	(0.505)		
High	0.0528654 ***	-.052768 **	0.0000974	0.0093792	0.5324	11,458
	(0.008)	(0.013)	(0.9899)	(0.190)		
Low-High	-0.0507777**	0.0584704**		-0.014528		
	(0.0318)	(0.0202)		(0.1677)		
Panel B: PEAD						
Low	.0389331	-.0262535	0.0126796**	-.0050811	0.5689	15,976
	(0.159)	(0.351)	(0.0044)	(0.372)		
High	0.094697**	-0.0965278**	-0.0018308	0.0000756	0.5335	6,873
	(0.013)	(0.016)	(0.8797)	(0.997)		
Low-High	-0.0557639*	0.0749625**		-0.0047586		
	(0.0756)	(0.0353)		(0.8093)		
Panel C: IFRS enforcement						
Low	.0617873**	-.0604251**	0.0013622	-.0026406	0.5301	11,429
	(0.031)	(0.045)	(0.8802)	(0.807)		
High	0.05051	-0.0361909	0.0143191***	-0.0036942	0.5729	11,410
	(0.117)	(0.270)	(0.0058)	(0.523)		
Low-High	0.0112773	-0.0242342		0.0010536		
	(0.7398)	(0.4841)		(0.9214)		
Panel D: Individualism						
Low	0.0113341	-0.0002621	0.011072	-0.00383	0.5469	11,410
	(0.732)	(0.994)	(0.0403)	(0.583)		
High	.0729191 ***	-.074897***	-0.0056814	.0093317	0.7716	11,429
	(0.000)	(0.000)	(0.4303)	(0.264)		
Low-High	-0.061585*	0.074635**		-0.013161		
	(0.0838)	(0.0433)		(0.2206)		
Panel E: Indulgence						
Low	0.0061956	0.0018851	0.0080807	-0.001712	0.5986	11,433
	(0.842)	(0.953)	(0.1568)	(0.779)		
High	.0725923***	-.0692381***	0.0033542	.0047564	0.5073	11,406
	(0.000)	(0.000)	0.5951)	(0.549)		

Low-High	--0.0663967**	0.0711232**		-0.006468		
	(0.0214)	(0.0164)		(0.4458)		
Panel F: Rule of law						
Low	0.0255941	-0.0215653	0.0040288	-0.0018991	0.5615	11,476
	(0.440)	(0.523)	(0.5772)	(0.801)		
High	.0524228*	-.042597	0.0098258	.0004618	0.5549	11,364
	(0.090)	(0.175)	(0.0807)	(0.946)		
Low-High	-0.0268287	0.0210317		-0.002360		
	(0.4548)	(0.5614)		(0.7393)		
Panel G: Number of analysts per company						
Low	-.0182781	.0206316	0.0023535	.0010483	0.5897	11,386
	(0.391)	(0.361)	(0.7411)	(0.896)		
High	0.0685765**	-0.0579889*	0.010588*	-0.0045677	0.5396	11,453
	(0.015)	(0.044)	(0.0968)	(0.570)		
Low-High	-0.086854***	0.0786205***		0.005616		
	(0.0002)	(0.0009)		(0.5955)		

Note: This table presents results for model (3) estimated in subsamples. ***, **, * denotes significance at 1%, 5%, 10% level, respectively.