



UNIVERSITA' DEGLI STUDI DI PADOVA

**DIPARTIMENTO DI SCIENZE ECONOMICHE ED AZIENDALI
"M. FANNO"**

**CORSO DI LAUREA MAGISTRALE IN
BUSINESS ADMINISTRATION**

TESI DI LAUREA

**"BROKER IDENTITY AND MARKET QUALITY:
DOES IT WORTH TO REVEAL YOURSELF AFTER A TRADE?"**

RELATORE:

CH.MA PROF.SSA CINZIA BALDAN

LAUREANDA: LUCIA SCHIONA

MATRICOLA N. 1082339

ANNO ACCADEMICO 2015–2016

Il candidato dichiara che il presente lavoro è originale e non è già stato sottoposto, in tutto o in parte, per il conseguimento di un titolo accademico in altre Università italiane o straniere. Il candidato dichiara altresì che tutti i materiali utilizzati durante la preparazione dell'elaborato sono stati indicati nel testo e nella sezione "Riferimenti bibliografici" e che le eventuali citazioni testuali sono individuabili attraverso l'esplicito richiamo alla pubblicazione originale.

Firma dello studente

TABLE OF CONTENTS

| | |
|---|-----------|
| INTRODUCTION | 6 |
| | |
| Chapter I - TRANSPARENCY AS KEY FEATURE OF MARKET DESIGN: IMPLICATIONS ON MARKET QUALITY | 10 |
| 1.1 Preface | 10 |
| 1.2 Market transparency: definition and dimensions | 11 |
| 1.3 The view of transparency among regulators | 12 |
| 1.4 Transparency as means to support price formation and investor protection in fragmented markets: MiFID requirements | 17 |
| 1.4.1 The path towards the implementation of MiFID II and MiFIR | 17 |
| 1.4.2 From MiFID I to MiFID II: the major changes | 18 |
| 1.4.3 Trade transparency requirements under MiFIR | 19 |
| 1.4.3.a. Pre- and post-trade transparency regime for trading venues: equity instruments | 19 |
| 1.4.3.b. Pre- and post-trade transparency regime for trading venues: non-equity instruments | 22 |
| 1.4.3.c. Pre- and post-trade transparency regime for systematic internalisers and investment firms trading OTC: equity instruments | 24 |
| 1.4.3.d. Pre- and post-trade transparency regime for systematic internalisers and investment firms trading OTC: non-equity instruments | 26 |
| 1.5 The literature review | 26 |
| 1.5.1 The literature review on pre-trade transparency and its impact on market quality ... | 26 |
| 1.5.2 The literature review on post-trade transparency and its impact on market quality: LSE case | 31 |
| | |
| Chapter II - A FOCUS ON ANONIMITY: IS THE DISCLOSURE OF BROKER ID CODES GOOD FOR THE MARKET? | 35 |
| 2.1 Preface | 35 |
| 2.2 Anonymity: a world tendency | 36 |
| 2.3 Broker identities: a conveyor of information to market participants | 39 |
| 2.4 Is the removal of broker identification beneficial for the market? Who benefits the most? | 42 |
| 2.4.1 Pre-trade information about broker identifiers and market quality | 43 |

| | |
|--|----|
| 2.4.2 Post-trade information about broker identifiers and market quality | 50 |
| 2.4.3 Pre-trade and post-trade information about broker identifiers and market quality ... | 54 |
| 2.5 Concluding remarks | 57 |

Chapter III - EMPIRICAL ANALYSIS OF THE INTRODUCTION OF POST-TRADE ANONYMITY ON “NUOVO MERCATO” OF BORSA ITALIANA 61

| | |
|---|----|
| 3.1 Preface | 61 |
| 3.2 The research question: why Nuovo Mercato? | 62 |
| 3.3 Institutional details | 62 |
| 3.4 The event | 67 |
| 3.5 The data | 69 |
| 3.5.1 Data source | 69 |
| 3.5.2 The sample period..... | 70 |
| 3.5.3 The main sample | 70 |
| 3.5.4 The control sample | 71 |
| 3.6 The model specification | 80 |
| 3.7 The results | 85 |
| 3.7.1 Post-trade anonymity and liquidity: overall market implications | 86 |
| 3.7.2 Post-trade anonymity and liquidity: cross-sectional implications..... | 87 |
| 3.7.2.a. Small vs. large stocks..... | 87 |
| 3.7.2.b. Low vs. high depth stocks..... | 92 |
| 3.8 Concluding remarks | 95 |

CONCLUSIONS..... 98

REFERENCES101

ACKNOWLEDGEMENTS106

INTRODUCTION

O’ Hara (1995) defines market transparency as “*the ability of market participants to observe information about the trading process*”. It entails pre-trade transparency (i.e. display of order book information: bid and ask quotations and market depths), post-trade transparency (i.e. public and timely dissemination of trade information: execution time, volume, price and direction of trades) and anonymity (i.e. information about the identity of brokers submitting orders either pre- or post-trade).

From a general point of view, all securities regulators advocate the importance to have highly transparent financial markets. Such environments, in fact, facilitate the price formation process, encourage investors to trust the market and participate, ensure best execution. In addition, they guarantee the fairness of trading and increase market participants’ awareness in making decisions.

Also the Financial Crisis Inquiry Commission, when identifying the causes of the Great Recession, acknowledged the stabilizing effect of market transparency. The lack of transparency magnified the dangers of the heavy debt taken on by financial institutions, spreading the panic among investors¹.

Despite being generally desirable, when we come to consider transparency as a market design feature its implications on market quality become unclear.

In the evaluation of the adequacy of transparency arrangements in the UK secondary bond markets, the Financial Services Authority stated: “*Transparency is not an end in itself. Total transparency is not necessarily optimal, and appropriate transparency levels may differ from market to market*”². Thus, regulators’ aim is to establish the right degree of transparency that guarantees sufficient liquidity, informational efficiency and investor protection. In other words, what regulators should obtain are properly functioning financial markets. This goal has been accomplished in the European Union through the implementation of MiFID I and, then, MiFID II with MiFIR.

This thesis focuses on the third dimension of market transparency, i.e. anonymity.

¹ The Financial Crisis Inquiry Report – The Financial Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States – Official Government Edition, January 2011.

² “Trading Transparency in the UK secondary bond markets”, Financial Trading Authority, Discussion paper 05/5, September 2005: pg. 23

More specifically, it aims at assessing *how the introduction of post-trade anonymity in “Nuovo Mercato”*, i.e. the equity market of Borsa Italiana for innovative and high growth companies, *affected liquidity*. Broker identities started to be concealed after-trade in 2004, following the implementation of a CCP system managed by Cassa di Compensazione e Garanzia. This study is innovative because, to my knowledge, no one in literature has investigated the effects of post-trade anonymity on the Italian Stock Exchange. Besides from the empirical analysis, the originality of my thesis stems also from the approach with which the review of the literature investigating market quality implications of transparency has been conducted. All research papers have been classified according to the peculiar dimension of transparency investigated, while generally a clear distinction is not drawn.

The thesis is organized as follows.

Chapter I outlines the concept of market transparency and captures the perception among securities regulators (CONSOB, SEC, IOSCO, SIB and Office of Fair Trading) about the importance to have lit financial markets. Then, transparency requirements for equity and non-equity instruments imposed by the new regulation of EU investment services and securities markets (MIFIR and MIFID II) are analysed. The Chapter ends with an overview of the transparency literature investigating the impact of pre- and post-trade transparency on market quality and specifically on informational efficiency and liquidity.

Chapter II is entirely dedicated to anonymity and starts with an excursus of the recent reforms undertaken by stock exchanges around the world in the dissemination of traders' identity. The common trend has been toward the concealment of broker ID codes both before and after order execution and it has been driven by the widespread belief among regulators of enhanced market quality. Finally, the chapter investigates the informational value of broker ID codes and provides an overview of academics' findings about market quality implications of pre- and post-trade anonymity.

Chapter III deals with the empirical analysis which consists in replicating the study conducted by Friederich and Payne (2011). These academics analysed the equity trading platform SETS of the LSE around the implementation of a Central Counterparty system in 2001.

More specifically, I attempted to reproduce their research in Nuovo Mercato, the Italian electronic order-driven equity market for high tech-firms and conventional businesses with product, process or logistics innovations.

The period under observation includes fourteen months before and six months after January 26 2004, on which date post-trade counterparty identification ceased. In fact, since then, Cassa di Compensazione e Garanzia has resulted as the counterparty of every trade.

As the identity of brokers placing orders in the book was already concealed, trading became completely anonymous.

The month of January 2004 was not included in the sample period because some tests took place to assess the new trading procedure. Over the observation period no change in the level of pre- and post-trade transparency occurred.

As far as the construction of the main sample (hereafter “treated” sample) is concerned, my initial intentions were to include all 43 stocks listed on Nuovo Mercato during the observation period. However, only 11 shares were considered because the database Datastream provided either no data at all or insufficient information to run the regressions necessary to conduct my analysis.

The sample companies represents about 67% of total market capitalization of Nuovo Mercato as at 31 December 2003, and 80% of total traded value over the year preceding the event.

Furthermore, heterogeneity across stocks in terms of market capitalization, inside bid-ask spread and turnover by value is observed.

Friederich and Payne (2011) focused on a particular aspect of market quality, i.e. liquidity, and investigate the impact of post-trade anonymity on inside bid-ask spreads, bid-ask spreads at the fifth limit price and depths available at those spreads.

To evaluate the policy effect on these liquidity measures, these academics employed a difference-in-difference panel model which uses a control sample to eliminate confounding factors and to identify the average treatment effect on the treated stocks.

I followed the same methodology for Nuovo Mercato, selecting the control stocks from Stoxx Europe 600 constituents. For comparability reasons, I picked only the constituents operating in the same industries as the firms included in the treated sample: technology and telecommunications sectors. Furthermore, I discarded those stocks traded at stock exchanges that saw the introduction of a CCP system over the sample period.

For efficient causal inference purposes, I used the propensity score matching technique which allows to create a control group as comparable as possible (on the basis of observed baseline characteristics) to the treated group.

The final comparison sample included 5 out of 12 candidate stocks.

The limited availability of data forced me to restrict the analysis on just one liquidity measure: inside bid-ask spread. Nonetheless, some interesting observations could be done about the

cross-sectional implications of post-trade anonymity on the width dimension of liquidity and the theoretical argument explaining these implications.

Significant, even if partially, results are obtained.

Chapter I

TRANSPARENCY AS KEY FEATURE OF MARKET DESIGN: IMPLICATIONS ON MARKET QUALITY.

1.1 Preface

Trade transparency is advocated by regulators of all over the world as one of the bricks of healthy financial markets. Indeed, it eases the price formation process, it induces investors to trust the market and to participate, and ensures best execution. Furthermore, a transparent environment favours the development of fair trading and enables market participants to take more aware investment decisions.

Even if from a general point of view market transparency is always desirable, when we come to consider it as a market design feature no common consensus emerges among regulators and academics over its impact on market quality.

Neither pre- nor post-trade transparency should be completely eliminated but appropriately calibrated for the type of financial instrument and the specific characteristics of the trading system (order-driven, quote driven, hybrid or voice broking system).

Regulators' aim is to establish the right degree of transparency that guarantees sufficient liquidity, informational efficiency and investor protection. In other words, what regulators should obtain are properly functioning financial markets.

This chapter is organized as follows. Section 1.2 defines market transparency and illustrates its three dimensions (pre-trade transparency, post-trade transparency and anonymity).

Section 1.3 focuses on the debate among securities regulators (CONSOB, SEC, IOSCO, SIB and Office of Fair Trading) about the importance to have “lit” securities markets. The next session is dedicated to the analysis of the new regulation of EU investment services and securities markets (MIFIR and MIFID II), which greatly innovates transparency regime. The chapter ends with an overview of trade transparency literature.

1.2 Market transparency: definition and dimensions

The definition of market transparency, commonly used in many research papers, is the one provided by O’ Hara (1995): “*the ability of market participants to observe information about the trading process*”. Informally, it can be explained as the disclosure of information about the current opportunities to trade and recent trading history.

The notion of transparency has to do with the informativeness of the order flow and the process of price discovery. The extent of trading data dissemination is contingent on the propensity of market participants to reveal and the exchange’s ability to publicly disclose buy and sell orders.

Transparency is a three-dimensional pillar of market microstructure; it entails³:

- *Pre-trade transparency*: display of order book information, i.e. current bid and ask quotations, market depths and other data such as limit orders away from the best prices, the existence of large order imbalances. This knowledge may be made available to all market participants or restricted to only a subset (brokers/dealers).
- *Post-trade transparency*: public and timely dissemination of trade information, i.e., execution time, volume, price and direction of executed orders.
- *Anonymity*: information about the identity of investors submitting orders either pre- or post-trade.

Besides the type of information being revealed, also the *extent* of disclosure (brokers, customer, or public) and the *speed* of disclosure (real time or delayed) matter when analysing markets through the lens of transparency.⁴

One way that is often advocated to estimate the size of transparency is the deviation from real-time disclosure standard. The meaning of “real time” is not unanimous: no later than 10 seconds following execution in the United States⁵, within 3 minutes in all the EU exchanges (as a result of MiFID trade reporting requirements). The speed of disclosure usually varies according to trade size (the larger the trades, the longer the time frame between execution and publication), trade type (wholesale brokered trades are more likely to be subject to real time

³ I mention the definition of transparency dimensions provided by Hachmeister and Schiereck in “Dancing in the dark: post-trade anonymity, liquidity and informed trading”, 2010, *Review of Quantitative Finance and Accounting* 34, pp.145–177. Some authors like Madhavan (2000), Pham and Wersterholm (2013/2014) don’t consider anonymity as a third dimension but the information about market participant’s identity pre- and post-trade is included in pre- and post-trade transparency respectively.

⁴ Madhavan, A., (2000): pp.205-258.

⁵ On February 12 2015 the Securities and Exchange Commission approved the proposal filed by the Consolidated Tape Association (“CTA”) Plan participants to bring forward the deadline by which they must report trades from 90 seconds to 10 seconds. The CTA is the body in charge of overseeing the real time dissemination of trade and quote information in NYSE LLC(Network A) and BATS, NYSE Arca, NYSE MKT and other regional exchange (Network B) listed securities.

dissemination than wholesale dealer mediated trades) and market architecture (auction or dealer market).

1.3 The view of transparency among regulators

The recent history of financial crises has thought about the importance of transparency in stabilizing financial markets and its welfare consequences. The lack of transparency has been pointed out by the Financial Crisis Inquiry Commission as one of the factors that contributed to the exacerbation of the Great Recession. It, indeed, magnified the dangers of the heavy debt taken on by financial institutions, spreading the panic among investors⁶.

Not only in the financial crisis literature, but also across regulatory authorities transparency is generally perceived as a desirable feature of market design. This view clearly emerges from the statutory aims and functions of regulators.

The Commissione Nazionale per le Società e la Borsa (**CONSOB**), the public authority responsible for regulating the Italian financial markets, has as its core objective the protection of the investment public. This aim is pursued by performing, among others, the task of ensuring “*transparency and correct behaviour by financial market participants*”⁷. Similarly, the U.S. Securities and Exchange Commission (**SEC**) “*is concerned primarily with promoting the disclosure of important market-related information, maintaining fair dealing and protecting against fraud*”⁸. The International Organization of Securities Commissions (**IOSCO**), the international body that aggregates world’s securities regulators, establishes that securities regulation should be aimed at guaranteeing market fairness, efficiency and transparency and it specifies in Principle 27 that “*regulation should promote transparency of trading*”.

The IOSCO has in many occasions called for greater information dissemination to improve market quality: on the one hand pre-trade transparency facilitates the price formation process, it enhances market participants’ faith in the market and consequently liquidity; on the other hand post-trade transparency enables market users to verify whether they obtained better/worse prices with respect to other market users.

In its “Market 2000 Report” the Division of Market Regulation of the SEC states that even if U.S. equity markets are characterized by the highest level of transparency in the world, they still need to improve market information disclosure for their effective operation. Trading data

⁶ The Financial Crisis Inquiry Report – The Financial Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States – Official Government Edition, January 2011.

⁷ <http://www.consob.it>

⁸ <http://www.sec.gov/about/whatwedo.shtml>

should be disseminated in a more complete and less costly manner. The Division strongly believes that transparency advancements are pivotal in enhancing investors' confidence "*as professional attention is reconcentrated on finding the best market, providing information and judgment for the investor, and getting [the investor] the best net result*". In addition, in a context of proliferation of trading alternatives (regional stock exchanges⁹, third market dealers¹⁰, automated trading systems like PTS and internal systems operated by broker-dealers that cross their customers' orders and other broker-dealers' orders, trading in foreign stock exchanges through broker-dealers' trading desks at the main securities markets around the world) to primary markets (NYSE, AMEX and NASDAQ), widespread trade information has been advocated as a means to link the multiple market venues by allowing market participants to get a comprehensive understanding of supply and demand. In fact, one of the recommendations made by the Division is to encourage specialists and third market dealers in listed stocks to display limit orders that are priced better than the best quotes at Intermarket Trading System. In this way trading interests are fairly communicated to other markets.

When discussing the introduction of the Investment Services Directive (Council Directive 93/22/EEC of 10 May 1993), which was subsequently replaced by the Markets in Financial Instruments Directive (Directive 2004/39/EC, the so-called MiFID), the Securities and Investment Board (**SIB**), however, expressed a diametrically opposite view to the one previously highlighted. It called for a reduction of post-trade transparency by suggesting that too strict transparency requirements would have been detrimental to market efficiency and liquidity because market makers would have been forced to disclose their positions. This is especially true for block trades¹¹. To understand SIB position we need to analyse the particular market microstructure that characterized London Stock Exchange in the early 90's. At that time the London Stock Exchange market operated a competitive dealership in which prices and quantities of trades exceeding three times the Normal Market Size were published 90 minutes later. Originally, from January 1989 to January 1991, there was a 24-hour delay in the dissemination of prices for trades over £100.000.¹² The delay reduction is consistent with the Director of Fair Trading's opinion that delayed trade publication rules prejudice competitiveness.

⁹ In the US 5 regional stock exchanges are active: the Boston, Chicago, Cincinnati, Pacific and Philadelphia Stock Exchanges. They subtract a significant portion of orders, especially small customer orders, to NYSE and Amex (20%, and 16% respectively as reported in the first semester of 1993). They guarantee lower fees, speed of execution and primary market price protection.

¹⁰ The third market entails off-exchange execution of block trades and execution of transactions by market makers who are not members of an exchange. This trading alternative provides various incentives: fast, inexpensive service, cash discounts to firms with customer order flow.

¹¹ SIB, "Regulation of the United Kingdom Equity Markets", Discussion Paper, Feb. 1994, p. 11.

¹² Gemmill (1996): p. 1765

Dealer markets are, indeed, generally denoted by lower levels of both pre- and post- trade transparency than auction markets. This is because stock exchanges authorities have accommodated the requests from market makers to refine publication rules by introducing long delays for block trades.

On May 22, 2003, the National Association of Securities Dealers (NASD) submitted to the SEC the proposal to introduce post-trade anonymity feature to SuperMontage¹³. Until then, SuperMontage granted traders entering “Non-Attributable Quotes/Orders” pre-trade anonymity. This means that the identities of members submitting orders were not disclosed to market participants but only after a trade was executed. The proposed rule change called for the concealment of identification codes in the execution report sent to the parties to the trade and in the report created in Nasdaq’s Automated Confirmation Transaction Service. In particular, instead of the market participant identifier (MPID) the report will show a four-letter identifier i.e. SIZE. As a result, trading would have become completely anonymous.

Although the SEC generally promotes transparency as one of the hallmarks of a healthy market, it approved the proposal. The reason of such decision relies on the Commission’s belief that the rule change may prevent front-running by other market participants who infer from members’ IDs the existence of one or more large institutional customers. In this way the probability for members to fill customers’ orders at worse prices would be greatly reduced.

Yet, broker-dealers would enhance their ability to provide best execution to its clients. The Commission further stated that: “*post-trade anonymity....enhance(s) the quality of the Nasdaq market and provide(s) market participants with the benefits of anonymity currently being offered by ECNs and PCXE*”^{14,15}. In other words, competition and innovation would benefit. While it is generally desirable to have the highest possible level of information dissemination in the name of greater fairness, efficient information acquisition, market consolidation and best execution, when we come to consider the appropriate level of transparency, however, the stuff becomes more complicated and controversial.

This view was clearly stated by the Financial Services Authority (former Securities and Investment Board) in the evaluation of the adequacy of transparency arrangements in the UK secondary bond markets: “*Transparency is not an end in itself. Total transparency is not*

¹³ SuperMontage is a highly innovative trading platform implemented by NASDAQ in 2002. Its main advantages are: increased speed and capacity, lower costs (narrower spread) and best execution for traders and investors. The director of the SEC Division of Market Regulation, Annette Nazareth, stated with respect to SuperMontage that it “*adds a limit order book that is electronically displayed and executed through automatic execution. The system was designed to enable Nasdaq to compete more effectively with ECNs and other market participants.*”

¹⁴ ECNs and PCXE are two alternative order routing and execution services to SuperMontage.

¹⁵ Securities and Exchange Commission, Order Approving Proposed Rule Change by the National Association of Securities Dealers, Inc. Relating to a Post-Trade Anonymity Feature in SuperMontage, Federal Register, September 30, 2003, Vol. 68, No. 189, Notices: pg. 56366

necessarily optimal, and appropriate transparency levels may differ from market to market. We recognise also that there can be trade-offs between transparency and liquidity, and that in some cases access to liquidity pools may be at least as important as what is published and when.”¹⁶

The IOSCO identifies five factors contributing to the determination of the transparency level in a market¹⁷:

- **The market microstructure.** It can be defined as the area of finance that studies the way in which the exchange of assets takes place within a given regulatory framework. Traditionally, we distinguish between “*order-driven markets*” or “*auction markets*”, where trade occurs among public investors without dealer intermediation, and “*quote-driven markets*” or “*dealer markets*” where the counterparty of every transaction is a market maker. Whether market microstructure should play a role in shaping the need for transparency is a decision of regulators. In particular, two trains of thinking among regulators are worth to be mentioned. On the one hand, market transparency rules should be designed in order to facilitate the participation of risk-bearing intermediaries who strengthen stock market efficiency. On the other hand, market microstructure is irrelevant. This view clearly emerges from the Securities Act Amendment of 1975, Section 11A, which didn’t point out an optimal market microstructure but strongly encouraged the creation of a national market system.
- **Asymmetric information as a reason for trading.** Prompt dissemination of quotes, prices and volume is particularly desirable when some investors have an information advantage, which can be used to exploit other investors and broker-dealers. In fact, if all market participants have access to updated trade data, they will be able to detect the presence of insider traders.
- **Transaction volume.** Block trades prefer less transparent trading mechanisms because they hinder the dissemination of order size information and so front-running by other market participants. As a result, cost of transacting is significantly reduced.
- **Wholesale market and retail market interaction.** Two views should be distinguished. According to one approach, in order-driven markets if block traders trade off-exchange, opaqueness will make limit orders (retail traders) less willing to engage in block trading. As a result the limit order book depth will reduce.

¹⁶ “Trading Transparency in the UK secondary bond markets”, Financial Trading Authority, Discussion paper 05/5, September 2005: pg. 23

¹⁷ “Transparency on secondary markets” – A synthesis of the IOSCO debate, IOSCO Technical Committee Working party on the regulation of the secondary market, December 1992.

The way to deal with this problem is to create centralization, that is, to connect wholesale and retail markets. This can be achieved (among others) by broadcasting as soon as possible trade and price information both for retail and block trades.

As regards quote-driven markets, there is no need to provide limit order protection¹⁸ and so to blend the two submarkets. This is because only market orders are allowed. According to the second approach, instead, both dealer and auction markets would benefit from the immediate dissemination of greater and greater amount of quote information. It, indeed, enables to reach a good compromise in terms of fairness, volatility, immediacy, price discovery and to address both wholesale and retail investors' requests.

Which of the two views is right depends on the degree of information asymmetry in the wholesale market and on whether most of liquidity providers are retail traders.

The underlying assumption is that wholesale and retail markets are not in competition.

- **The extent of inter-exchange competition.**

Some arguments against and in favour of regulation in the area of inter-exchange competition are worth to be mentioned. Those who support free competition claim that less transparent markets may be able to gain the benefits of the price discovery process in the more transparent regulated exchanges without sharing in the costs of that transparency. This, as it is sometimes argued, provides an unfair competitive advantage to the former markets and is potentially harmful to the overall price discovery process. By contrast, those who are pro-regulation state that competition reveals detrimental for price formation process and liquidity supply in the least opaque market. Furthermore, a minimum degree of regulation is called for to manage the wholesale-retail markets interaction. Today fragmented markets generate significant price inefficiencies that can be overcome by promoting full transparency.

¹⁸ Limit orders are unprotected when they remain unexecuted for a long period of time. This is because large transactions occur at prices that don't match the current quotes.

1.4 Transparency as means to support price formation and investor protection in fragmented markets: MiFID requirements.

1.4.1 The path towards the implementation of MiFID II and MiFIR.

Investment services and securities markets were originally governed by the Council Directive 93/22/EEC of 10 May 1993, namely the Investment Services Directive (hereinafter “**ISD**”). The directive was intended to uniform around Europe the authorization and other operating requirements for investment firms and banks so that, once authorized by the Member State of origin, they were free to create subsidiaries or offer services everywhere in the Union.

In addition to the mutual recognition of authorization, this harmonization led to the application of the principle of home country supervision.

In the years that followed financial markets have undergone significant changes: they have become more populous and there have been an ever-increasing proliferation of heterogeneous services. This new scenario has brought concerns in terms of investors’ rights preservation and has, therefore, called for further harmonization.

To this end, the Directive 2004/39/EC (the so-called Markets in Financial Instruments Directive) was adopted in April 2004 and entered into force in November 2007 replacing the ISD.

The **MiFID** aims at releasing competitive forces in the provision of trading venues and execution facilities by creating a common EU market for investment services and activities and at enhancing the protection of equity investors.

On the one hand investors have benefited from tighter average bid-ask spread and lower transaction costs induced by stronger competition, on the other the consequent equity market decentralization and fragmentation have led to regulatory arbitrage.

When the 2008 financial crisis hit the world economies, strong transparency and corporate governance deficiencies emerged, especially in the non-equities market. One of the commitments made by the leaders of G20 during 2009 London Summit was to enhance transparency of the financial sector so as to guarantee its stability.

Furthermore, financial and technological advancements (the growth in high-frequency algorithmic trading) have exposed the need of extending the scope of MiFID provisions also to financial instruments traded in unregulated pools (Over-The-Counter) in order to boost transparency and underpin investors’ trust.

All these reform pressures have brought about the Directive 2014/65/EU of the 15 May 2014 (**MiFID II**), which is a partial recast of the Directive 2004/39/EC, and the Regulation (EU) n° 600/2014 (**MiFIR**). MiFID and MiFIR will come into force on 3 January 2017.

The MiFID review is aimed at widening the scope of the regulation into force and at reaching the maximum harmonization of the provisions among Member States. Consistently with this objective, many rules (in particular those concerning *transparency requirements*) included in the MiFID have been transposed in the MiFIR Regulation, which is directly applicable to all the Member States.

Both legal frameworks innovating the MiFID apply to “*investment firms, regulated markets, data reporting service providers and third country firms providing investment services or activities in the Union*”¹⁹.

1.4.2 From MiFID I to MiFID II: the major changes.

The financial markets regulation has been heavily innovated.

As far as *transparency* is concerned, waivers from the equity pre-trade transparency regime have been narrowed and a volume cap mechanism has been introduced in order to limit the use of such waivers. Furthermore, pre- and post-trade transparency regime, which was previously restricted to shares, has been broadened to equity-like (depository receipts, ETFs, certificates and other similar financial instruments) and non-equity instruments (bonds, structure finance products, emission allowances and derivatives).

In addition to regulated markets (RMs), multilateral trading facilities (MTFs)²⁰ and systematic internalisers (SIs)²¹, a new *regulated trading venue* has been created: the organized trading facility (OTF). The OTF regime is defined by art. 4(1)(23) of the Directive 2014/65/EC as “*a multilateral system which is not a regulated market or an MTF and in which multiple third-party buying and selling interests are able to interact in a system in a way that results in a contract in accordance with Title II of the Directive*”.

The pre- and post-trade transparency requirements governing RMs and MTFs apply in the same way to this new trading platform but client orders are executed on a discretionary basis. Moreover, trading on OTFs is restricted to non-equity instruments only.

This regulatory change is expected to reduce OTC trading so as to reach a level playing field. In order to ensure financial stability and orderly trading conditions, limits have been imposed on *high-frequency algorithmic trading* and on *commodity derivatives*.

¹⁹ Directive 2014/65/EU: p. 2

²⁰ Art. 4(1)(19) of Directive 2014/65/EC provides the definition of multilateral facility: “*any system or facility in which multiple third-party buying and selling trading interests in financial instruments are able to interact in the system*”.

²¹ Pursuant to art. 4(1)(20) of Directive 2014/65/EC a systematic internaliser is “*an investment firm which, on an organized, frequent systematic and substantial basis, deals on own account when executing client orders outside a regulated market, an MTF or an OTF without operating a multilateral system*”.

On the one hand high-frequency algorithmic trading, like every technological innovation, brings many advantages: it mitigates volatility in the short-run, enables easier market access and participation, enhances liquidity, it tightens bid-ask spreads and improves the market conditions at which clients' orders are executed. On the other, instead, it may create havoc in the market by overloading the system or by exacerbating the reaction to market events.

Investment firms carrying out algorithmic trading must comply with several obligations. They are required to make sure to have resilient trading systems and adequate capacity to face severe market stress. The way to do this is by implementing systems and procedures limiting the proportion of unexecuted orders, slowing down order flow and imposing a minimum tick size. They have also notification duties of their trading activity to the competent authorities of the home Member State and to the trading venue of which they are participants.

Furthermore, operators of a trading venue must implement a “circuit breaker” to temporarily stop or constrain trading in unusual conditions.

Finally, they are required to keep track of the placed, cancelled, executed orders and quotes.

To reduce market volatility generated by speculative attacks on commodities, the size of the net position held in commodity derivatives is not allowed to overcome a specific threshold or position limit.

One last significant regulatory innovation is the requirement to trade *derivatives*, which are subject to clearing obligations and are sufficiently liquid, in RMs, MTFs or OTFs.

1.4.3 Trade transparency requirements under MiFIR.

1.4.3.a Pre- and post-trade transparency regime for trading venues: equity instruments.

Before going into detail, the analysis of the topic at hand should start from the identification and definition of equity instruments falling within the scope of MiFIR.

Three macro classes of securities are subject to transparency requirements:

1. *Transferable securities*: financial instruments dealt in on the capital market excluding instruments of payment (art. 4(1)(44) of MiFID II). Within this category, we find:
 - a. shares in companies, partnerships or other entities;
 - b. exchange-traded funds which, for the purpose of MiFID II, shall have at least one unit negotiated over the day on at least one trading platform with at least one market maker ensuring that not significant price fluctuations from the unit's net asset value occur.
 - c. depositary receipts: financial instruments tradable on the capital market and giving a non-domiciled issuer the ownership right on certain

securities. In addition, they shall be admitted to trading on a regulated market and they must be traded independently of the securities of the non-domiciled issuer.

- d. certificates: securities tradable on the capital market giving underwriters, in the case of repayment by the issuer, priority over shares but not over unsecured bond instruments and equivalents;
2. *Money market instruments*: securities usually traded on the money market including treasury bills, certificates of deposit and commercial papers. This category doesn't encompass instruments of payment (art. 4(1)(17) of MiFID II);
3. *Units in collective Investment undertakings* (Annex I Section C(3) of MiFID II).

With respect to the latter two macro classes, no compulsory transparency system applies.

Before trades take place, market operators and investment firms²² running one of eligible trading venues under MiFID II shall publish continuously, during normal trading session, *current bid and offer prices and the depth of trading interests* (or quantities) at those prices. This shall hold for shares, equity-like instruments and actionable indication of interests negotiated on a trading venue.

The actionable indication of interests refers to the communication by one member of a trading venue to another of his or her buying/selling interest in a security.

Transparency rules need to be adjusted not only for the type of financial instruments (equity or non-equity) but also to cope with the particular characteristics of the trading system: order-book, quote-driven system, hybrid or voice broking system. This is because the heterogeneity within and across asset classes makes inappropriate a one-size fits all approach.

While shares and equivalents are commonly traded in centralized auction markets, non-equity markets are typically decentralized dealer markets.

Returning to the issue at hand, investments firms required to disclose their quotes shall be granted access indiscriminately and at reasonable commercial conditions to the information publication procedures put in place in the trading venue.

However, the Competent authorities are allowed to *exempt* RMs, MTFs and OTFs from pre-trade transparency requirements if one of the following conditions are met:

- i. *Reference price system*: in an eligible trading venue orders are matched according to a price, which is obtained from another market. This other market is the one where the financial instrument is allowed to be traded for the first time or the most

²² Investment firms under art 4(1)(1) of Directive 2014/65/EU are legal persons who provide investment services and/or perform investment activities as their main business.

- liquid market. The reference price shall be widely published and perceived as reliable by market participants;
- ii. *Platforms formalizing negotiated transactions at prices different from current market conditions*: transactions take place within the current volume weighted spread on the order book or the market-maker quotes or within a percentage of a suitable reference price where the financial instrument is illiquid²³;
 - iii. *Orders that are larger than normal market size*;
 - iv. *Orders held in an order management facility* waiting for display (i.e. “iceberg orders”).

The competent authority receiving a waiver application, before granting the exemption, must seek European Securities and Markets Authority (ESMA)’s approval at least 4 months before the waiver is intended to take effect. ESMA shall issue its non-binding decision by 2 months. The use of the waivers is subject to supervision by the granting competent authority which can withdraw the waiver if its use doesn’t comply with the MiFIR requirements.

One of the most important regulatory innovation from MiFID I is the introduction of a *double volume cap mechanism* restricting the use of reference price and the negotiated price waivers²⁴. The rationale of this change is to minimize trading on dark pools and to prevent distortions in the price formation process.

Under the volume cap mechanism, trading exempted from pre-trade transparency regime for one of the two reasons is not allowed to exceed 4% on a single trading venue and 8% on all EU trading venues of the total volume of trading in that financial instrument in the Union over the last year. The overcoming of the two limits triggers the suspension by the competent authority of the use of the waiver on that venue (in the case of the 4% cap) or across EU (in the case of the 8% cap) in that financial instrument for 6 months.

The cap rule doesn’t apply to order-management facilities and large-in-scale transactions waivers. Large orders would execute at worse prices if they were displayed before the trade. Also negotiated transactions in equities, which are not traded on a continuous basis, within a percentage of a suitable benchmark price and negotiated transactions at terms far from the current market price don’t fall within the scope of the cap mechanism.

²³ Under MiFIR, in the case of equity instruments, a liquid market is a market where the financial instrument is negotiated every day. Besides daily trading, other criteria must be mutually met in order for equities to be liquid: free float (not less than €500 m under MiFID I), average daily number of transaction (not less than 500 under MiFID I) and average daily turnover (not less than €2 m). ESMA in its Final Report of 19 December 2014 expressed its intention to reduce the MiFID I thresholds in order to enable the achievement of the target of greater transparency.

²⁴ Only negotiated transactions at a price inside the volume weighted spread on the order-book or the quotes of market makers fall within the scope of the double volume cap mechanism.

On a *post-trade* basis, the operators of a trading venue are required to disclose, as quickly as possible, price, volume and time of executed transactions. Under MiFID I the real-time reporting obligation is complied with if transaction details are published within 3 minutes from the execution. ESMA, however, proposes in its Discussion Paper of 22 May 2014 about MiFID II and MiFIR to reduce this time limit to 1 minute because in this way the quality of post-trade information and the overall market transparency would be enhanced.

The European Commission is empowered by article 7(2)(a) of MiFIR to define the content of post-trade information subject to publication. ESMA, in turn, shall issue regulatory technical standards (RTS) implementing the new transparency requirements. Under the Implementing Regulation 1287/2006, article 27(1), the following transaction data are required to be disseminated:

- i. *the trading day and time;*
- ii. *the instrument identifier;*
- iii. *the unit price and price notation;*
- iv. *the quantity,* and
- v. *the venue identifier (RM, MTF, SI or OTC).*

All these details enable the discovery of liquidity pools and, therefore, let investors to make more conscious decisions.

The access to post-trade information shall be granted in a non-discriminatory way and at reasonable commercial conditions.

Furthermore, competent authorities may grant waivers from the real-time reporting rule by admitting a publication delay on the basis of the type and size of the transaction. Specifically, orders that are larger than normal market size are subject to deferred display.

The intention of the operators of a trading venue to make use of the exemption must be previously authorized by the competent authority and made public.

1.4.3.b Pre- and post-trade transparency regime for trading venues: non-equity instruments

With a view to enable sounder, more efficient, competitive and transparent EU financial markets, the scope of MiFID I has been extended to non-equity assets.

In particular:

1. *Bonds*, transferable securities tradable on the capital market including depositary receipts in respect of bonds (art. 4(1)(44)(b)) of MiFID II);
2. *Sovereign debt*, debt instrument issued by:

- a. The Union;
 - b. The government, an agency or special purpose vehicle of a Member State;
 - c. A member of the federation in the case of a federal Member State;
 - d. A special vehicle purpose for a number of Member States;
 - e. An international financial body created by a group of Member States with the aim to provide financial aids to the fellows facing severe financial problems;
 - f. The European Investment Bank (art. 4(1)(60) and (61) of MiFID II).
3. *Structured finance products*, a kind of transferable securities, arising from the securitization of a pool of financial assets, which gives underwriters the right to receive payments based on the cash flow generated by the underlying assets. Asset backed securities belong to this asset class (art. 2(1)(28) of MiFIR).
4. *Derivatives*. Under art. 2(1)(29) of MiFIR this category includes securitised derivatives (i.e. covered warrants certificated derivatives, negotiable rights and warrants attached to bonds and medium term notes tracking the performance of another assets) and derivative contracts (i.e. interest rate derivatives, foreign exchange derivatives, equity derivatives, commodity derivatives, credit derivatives and other derivatives).
5. *Emission allowances* defined by Annex I, section C 11 of MiFID II as “ *consisting of any units recognised for compliance with the requirements of Directive 2003/87/EC (Emissions Trading Scheme)*”.

In the *pre-trade* phase non-equity instruments are subject to the same requirements of equities in terms of information content to be made public, calibration of transparency rules based on the type of trading system and access to published information at a non-discriminatory and reasonable cost.

The only difference concerns the exemptions from the pre-trade transparency regime.

Waivers are granted by the competent authority for: *large in size* orders and orders kept in an *order management facility* on a trading venue waiting for display (like equity-instruments); actionable indications of interest in request-for-quote and voice trading systems *above a specific size* to the financial instrument; derivatives which are not subject to the trading obligation and *illiquid*²⁵ financial instruments.

²⁵ For the purpose of MiFIR, in the case of non-equity instruments, a liquid market is a market for a financial instrument where there is continuous availability of buyers and sellers willing to trade. Four criteria are used in assessing whether non-equities are liquid: average size of transactions (total turnover over a period divided by # of trading days in that period), average frequency of transactions (minimum # of transactions over a specific period and minimum # of trading days on which at least 1 transaction occurred over a specific period), data

Furthermore, when an exemption is recognized to actionable indication of interests, operators of trading venue are required to disclose, continuously during the trading day, indicative pre-trade bid and offer prices.

Even for non-equity assets, Member State regulators have notification duty to ESMA and are empowered to withdraw the waiver under the same circumstances established for equity instruments. They may also provide for a temporarily suspension of the pre-trade transparency obligations, should liquidity fall under an established threshold.

As far as *post-trade* transparency is concerned, some (although subtle) distinctions from the regime designed for shares and equivalents can be outlined. In particular, on ESMA's proposal, an additional information should be disclosed: the quantity notation (nominal value or number of units). Furthermore, “*escapes*” from the real-time reporting requirement may be provided not only for *large in scale* trades but also for *illiquid* financial instruments, *above specific size* transactions posing excessive risk to liquidity suppliers and for *types* of transactions. The competent regulators have the authority to suspend for a maximum of 3 months post-trade transparency obligations with respect to non-equities whose liquidity is become lower than a defined level. ESMA is mandated to clarify the methods for the calculation of the instrument-specific liquidity threshold.

Once authorized, the publication delay doesn't necessarily imply the omission of all details of the transactions during the deferred period. Indeed, the national competent authorities may call for the disclosure of limited pieces of information of many transactions on an aggregated basis and/or require the concealment of the volume of an individual transaction for an extended period of deferral.

At the end of the deferral period all information must be disseminated, unless the financial instruments are sovereign bonds. In the latter case, in fact, the publication of several transactions in an aggregate form for an indefinite time period may be granted.

1.4.3.c Pre- and post-trade transparency regime for systematic internalisers and investment firms trading OTC: equity instruments.

Under article 4(1)(20) of MiFID II systematic internalisers are investment firms executing client orders on own account away from regulated markets, MTF or OTF and the conduct of this activity is *organized, frequent* and *systematic*, and *substantial*.

The “frequent and systematic” criterion must be assessed looking at number of OTC transactions in the financial instrument executed by the investment firm when dealing on own

related to market participants (number and type) and average size of transactions (end-of-day relative bid-ask spreads as published by the most relevant market in terms of liquidity).

account. In order for the investment firm to qualify as SIs in respect of equities, this figure shall be, over the last 6 months, at least 0,4%²⁶ of the total amount of transactions carried out in the Union on any trading venue or OTC in the same spell.

The “substantial” requirement, instead, must be assessed taking into account the size of OTC transactions executed by the investment firm with respect to the total trading of the investment firm in a specific financial instrument or the total trading in the EU in a specific financial instrument. ESMA clarified that these two ratios shall be, over the last 6 months, at least 15% and 0,4% respectively for the SIs regime in respect of equities to apply.

Investment firms that don't meet these thresholds may anyway be subject to SIs transparency requirements if they voluntarily opt to. On ESMA's proposal, investment firms should verify their compliance with the criteria every 4 months.

The SIs regime has been introduced in order to shift dark trading to lit platforms as much as possible. With this aim in mind, MiFIR provides for precise transparency obligations ensuring efficient price discovery and fair trading among venues.

Systematic internalisers are required to disclose *firm quotes* regularly and continuously during the normal trading day. Every quote, for each financial instrument, must be two-sided: it shall consist of both a bid price and an ask price.

This requirement applies to liquid equity instruments traded on a trading venue, provided that the size of transactions is not larger than the standard market size. If a liquid market doesn't exist, SIs must publish quotes only upon customer's solicitation.

Quote revision and (only exceptionally) withdrawal are permitted.

Furthermore, access to quotes shall be granted at a reasonable cost and SIs can use their discretion in choosing to which clients they want to provide pre-trade information.

On a *post trade* basis, volume, price of the transaction and time of execution shall be made public by means of an approved publication arrangement (“APA”)²⁷. Unlike pre-trade transparency obligations, post trade reporting rules don't discriminate between liquid and illiquid instruments.

Deferred publication may be authorised under the same circumstances established for regulated markets, MTF and OTF.

²⁶ For illiquid equity instruments the frequent and systematic criterion is satisfied, if the activity is carried out in the same financial instrument daily over the last semester.

²⁷ APA is defined as by art. 4(1)(52) of MiFID II as “a person authorized under this Directive to provide the service of publishing trade reports on behalf of investment firms”.

1.4.3.d Pre- and post-trade transparency regime for systematic internalisers and investment firms trading OTC: non-equity instruments.

The thresholds, used to assess whether an investment firm is eligible for SIs regime, varies for each class of non-equities and for the instrument-specific liquidity characteristics.

Post-trade transparency requirements are homogenous to the ones established for shares and equity like instruments. The pre-trade transparency regime, instead, differs just for two facts:

1. For liquid instruments, the publication of firm quotes is mandatory only if a quote is called for by the client of the systematic internaliser and if the SI is willing to provide such a quote.
2. For illiquid instruments, if systematic internalisers wish to provide a quote, they shall disseminate firm quotes upon customer's solicitation.

1.5 The literature review

In this section I am going to illustrate academics' findings about how the first two dimensions of transparency can affect the health of the market.

I decided to conduct a separate analysis for pre- and post-trade transparency because full transparency is not necessarily good and each dimension has peculiar effects.

1.5.1 The literature on pre-trade transparency and its impact on market quality

Academics envision very different effects of changes in the amount of pre-trade transparency on market soundness. The absence of a common agreement arises, probably, from the heterogeneity of the investigated trading venues (in terms of market structure, trading mechanism, market capitalisation), of market quality measures and the econometric technique employed.

Boehmer *et al.* (2005) study the NYSE around the implementation of the OpenBook service in January 2002. Before analysing the regulatory change, some information about the institutional features needs to be provided.

The NYSE is the world's largest stock exchange by market capitalisation. It is an hybrid market characterized by the co-existence of an automated order driven market (SuperDot) and a floor based quote driven market (NYSE floor).

On the floor, trading of each stock takes place in a designated trading post where a specialist acts as a trade facilitator. Investors represented by floor brokers form a crowd around the trading post to find the best bid or ask price. The bid and ask offers are called out loud in order to induce interested counterparties to participate. Besides through floor brokers, the specialist can receive investors' orders electronically via SuperDot system.

The specialist doesn't only bring buyers and sellers together but also softens order imbalances by acting as a dealer.

The introduction of the OpenBook service has made visible to traders off the NYSE floor the content of the specialist's limit order book. In particular, they are provided with instantaneous information about the depth available at each price level for all securities. Prior to the event, only the specialist knew about its limit order book and only the best bid and best offer were available to the public.

The enhanced pre-trade transparency poses on limit orders the risk of being front-run and of information leakages. In order to protect themselves against these risks, limit order traders change profoundly their tactics.

Boehmer *et al.* find empirical evidence of all but one predictions made by Harris (1996) about order exposure management. Higher cancellation rate of limit orders (# cancelled limit orders/#submitted orders), shorter time to cancellation (seconds between submission and cancellation) and a reduction in the size are observed in the post-event period (from February to May 2002). However, the authors don't discover an increase in the activity of floor brokers. Actually more order flow is routed electronically to limit order book. Such a result is in line with the view that the OpenBook makes visible to investors the impact of their trading and it therefore enables them to pursue strategies without the involvement of a floor broker. Investors are now more able to decide on their own whether to take or provide liquidity on the basis of the book conditions.

Also the specialist's behaviour changes in respond to the new regulatory scenario.

The publication of the content of the limit order book reveals to the market the confidential information that the specialist has access to by virtue of its position. As a consequence proprietary trading may be no longer a profitable strategy. This is one of the reasons why the depth that is added to the book reduces.

Another explanation of such a finding can be identified in the increased use of the SuperDot order-routing system by traders, since specialists are obliged to leave the ground to public investors at the same price or better when acting as dealers.

Market participants' new action plan leads to a more efficient and liquid market. Indeed, *lower fluctuations* of the transaction price *from the efficient price* and a random walk process of returns are observed following the study event.

After controlling for volatility, volume and price, the *effective spread*²⁸ of market and marketable orders *tightens* indicating a smaller price impact. Boehmer *et al.*, therefore, define the increase in pre-trade transparency as a “win-win situation”.

Madhavan *et al.* (2005) reach diametrically opposite conclusions when analysing the transparency rule change which took place in Toronto Stock Exchange in April 1990.

This institutional innovation consisted of the introduction of Market By Price computerized system that made accessible to the public real-time information about depth at the five best bid and ask prices.

Such pre-trade transparency expansion involved both the automated trading system CATS and TSE’s floor. However, the effects were stronger for the stocks traded in the floor because it was characterized by a lower level of transparency than CATS (the limit order book, in fact, was accessible only to the Registered Trader).

More specifically, *wider quoted and effective spread* (even after the inclusion of volume, price and volatility controls), reflecting a remarkable increase in the adverse selection component, are documented. Furthermore, the *return volatility increases* after the natural experiment and its magnitude is greater the further we are from April 1990.

As many theoretical models predict, stock prices do fall as a result of higher execution costs. No statistically significant impact is found with regard to the quoted depth in CATS stocks²⁹, since before the event it already disseminated the depth at each price level to its members. However, according to Madhavan (1996), the observed rise in volatility may be induced by a *reduction in bid and ask sizes*. Opening the book, in fact, makes more attractive market orders than limit orders because of the increase in monitoring costs.

In addition, specialists see its profit to dry up as they can no longer keep their informational advantage. Finally, Madhavan *et al.* conclude their survey by identifying other two drawbacks of transparent markets. On the one hand, gaming and market manipulation occur more frequently. On the other, large institutional investors migrate toward opaque trading venues (upstairs, off-exchange, after-hours, foreign exchanges) thereby worsening liquidity in lit markets.

The theoretical model developed by Angeles de Frutos *et al.* (2013) may be useful to reconcile the different results reported in the two empirical researches so far analysed. Angeles de Frutos *et al.* find that in *large markets* greater *transparency* in the form of public

²⁸ The effective spread is computed as double the difference between transaction price and the mid-quote.

²⁹ The effects of MBP introduction on quoted depth in floor traded stocks are biased in the sense that a potential increase may be due to the exposure of previously hidden liquidity. This is because, before the rule change, the Regulated Traders (specialists) could decide to display only an indicative depth.

dissemination of the noise component of the order flow is panacea. It, indeed, *enhances liquidity and mitigates price volatility*. By contrast, in markets where less active securities are traded the effects are ambiguous and are contingent on the value of the parameters.

Accordingly, market capitalization makes the difference. The Toronto Stock exchange and NYSE present similar market structure as both mix order-driven and quote-driven features, but the former is by far thinner than the latter.

Eom *et al.* (2007)'s empirical analysis of the Korea Stock Exchange, an order-driven market, shows the existence of a *positive* and *concave* relationship between pre-trade transparency and market quality: beyond a certain threshold an increase in the former induces an improvement in the latter but less and less³⁰.

Their findings are more robust than previous researches for two reasons.

First, they are based on a broader range of quality measures. Indeed, in addition to the traditional proxies (bid-ask spread, relative bid ask spread, market depth and transient volatility), market to limit order ratio, full-information trade cost (FITC)³¹ and the MRR implied spread in its two components (adverse selection cost and transitory cost) are considered.

Second, Eom *et al.* conduct a panel-data analysis which allows to control for variables directly influencing market quality like volume and price. The authors state that the empirical models employed by many academics are not reliable because either they don't include such controls or they use unsuitable techniques in doing it.

The implicit assumption underlying the studies examined so far is that the actual sizes and the exposed sizes in the limit order-book are the same. What if an exchange allows to submit "Iceberg" or "reserve" orders? What would be the consequences in terms of liquidity and informational efficiency?

Gozluklu (2014) provides an answer to these questions. In particular, the author observes that opacity in the form of hidden orders affects market quality differently according to the information set traders hold.

Two scenarios are envisioned: all traders equally informed; one monopolistic insider (or an auction for private information).

³⁰ Eom *et al.* exploit two natural experiments occurred in KRX. The first took place in 2000 and involved the dissemination of the 5 best prices instead of 3. The second, in 2002, extended further the amount of pre-trade information granted to the public by making visible 5 additional price levels.

³¹ FITC can be defined as the price incorporating all the public and private information available at a specific moment. The informational efficiency of prices is captured by gap between the actual trading price and FITC. This gap is called trade execution cost.

Under symmetric information, the opaque regime tightens bid-ask spreads and mitigates the price impact of market orders. In other words, the book becomes more resilient³² boosting market liquidity.

This is because under opacity conditions, liquidity traders (in particular the large ones³³) employ a different order exposure strategy. Limit orders are partially replaced with reserve orders and submitting fewer market orders pursues lower trading aggressiveness.

The possibility to partially hide order size allows to moderate the race among liquidity suppliers, to prevent scalping following a public information release and to hedge against price risk. Yet, in the absence of adverse selection, liquidity traders, and especially the large ones, earn higher trading profits in opaque markets to the detriment of noise traders.

Under the presence of a monopolist insider, instead, reduced transparency doesn't lead to a significant reduction of the bid-ask spread and therefore to more ample liquidity. This is because the impact of adverse selection costs outweighs the effect of exposure costs, except in the trading cycle during which a public information shock takes place.

The monopolist insider joins large liquidity traders in demanding and supplying liquidity.

It submits both hidden orders and less aggressively priced limit orders in order to prolong the exploitation of its informational advantage.

However, when the insider has to share the informational rents with another one, opacity does improve market quality through larger book depth. Furthermore, informational efficiency is enhanced by a faster value discovery process.

In opaque regime informed traders' welfare is increased at the expense of large liquidity traders.

Another important contribution to pre-trade transparency literature is provided by Bessembinder *et al.* (2009). Their study starts from the observation of undisclosed orders usage in Euronext and finds that 18% of incoming orders partially hide their size and 44% of order volume is concealed.

They also discover that hidden liquidity option is mainly used for less liquid firms and large trades. The picture that emerges shows that many traders benefit from a reduction in transparency. This means that if the Euronext didn't grant the possibility to expose only a portion of the actual order quantity, many market participants would move to alternative trading systems leading to market fragmentation. The consequences would be devastating both in terms of market quality and informational efficiency.

³² Market resiliency is one of the dimensions of liquidity and it can be defined as the speed with which prices come back to their previous levels after large order-flow imbalances triggered by uninformed trading.

³³ Large liquidity traders have a higher private valuation of the asset.

1.5.2 The literature on post-trade transparency and its impact on market quality: LSE case.

Many empirical studies on post-trade transparency focus on the examination of the delayed trade publication regime, which characterized the London Stock Exchange in the period 1986-1996. The beginning of that decade passed into the annals of the British financial history for the so-called “Big Bang” reform.

The “Big Bang” involved a radical deregulatory intervention and was aimed at giving the City of London the world primacy not only across many financial markets like the foreign exchange market but also in the securities business.

Some of the measures undertaken included the abolishment of fixed minimum commissions, the elimination of the single capacity rule preventing member firms from being brokers-dealers or dual traders, the possibility of outside ownership of member firms and the introduction of screen-trading. Such a bundle of reforms significantly increased the ability of the London quote-driven market to compete internationally.

Until 27 September 1989, prices and quantities of both block and small trades were revealed to the public immediately i.e. within 5 minutes. This post-trade transparency regime concerned market makers who claimed that instantaneous publication of large trades would have been detrimental to market liquidity.

The London Stock Exchange is known for its ability to provide immediacy to institutional traders and this requires dealers to keep a high level of inventory. The huge inventory risk forces market-makers to offer customers worse prices when trading with them. The result is fewer block trades.

Dealer’s complaints led to restrictions of transparency for large trades:

- in 1989 a 24 hour deferral in the dissemination of prices of trades exceeding £100.000 was introduced;
- in 1991 the delay was reduced to 90 minutes and it related trades whose size was more than triple Normal Market Size (both trade price and trade volume were subject to deferral);
- in 1993 the details of trades above 75 times NMS³⁴ were allowed to remain concealed for 5 business days. No rule change was introduced for trades above 3 times NMS which continued to be undisclosed for 90 minutes;

³⁴ Normal Market Size is the criterion used to classify stocks according to liquidity. This categorization is performed by taking into account the average transaction size of each stock. Before the introduction of NMS concept, securities used to be grouped into four classes: alpha (the most liquid shares), beta, gamma and delta.

- finally, in 1996 post-trade transparency was slightly enhanced via a curtailment of the deferral to 60 minutes for trades whose size exceeded 75 times NMS. This delay applied also to trades larger than 6 times (instead of 3 times) NMS, provided that they didn't take place among market-makers. The London Stock exchange set two objectives: at least 75% of the value of trading should have been disclosed with no delay and minimum 95% no later than 60 minutes. The reason why the exchange stepped back was the belief of Office of Fair Trading that the delayed publication regime would have damaged competition giving large market makers an unjust informational advantage.

Gemmill (1996)³⁵ finds that market makers' concern of a reduction in liquidity as a result of instantaneous publication is unjustified.

Delayed publication exerts no significant effect on the width of spreads on large trades compared to small trades. If a tightening/widening of spreads is observed, this is only attributable to volatility. Thus, *no liquidity improvement* is obtained.

Yet, the reduced post-trade transparency doesn't mitigate price movements after a block transaction nor it causes longer price adjustments. By contrast, the author finds evidence of a permanent price impact providing support to the hypothesis that large trades incorporate information. Nevertheless, during the deferral period market makers are not able to take advantage of the information they have access to by participating in block trades. In fact, the prices of two trades before a large purchase increase significantly indicating an outflow of information. No information leakage is, instead, observed before a large sale.

Thus, the argument that market makers use to oppose the immediate publication is unfounded. According to Gemmill, the actual reason why market makers call for delayed publication of block trades is to impede the creation of an upstairs market which would threaten their position.

Board *et al.* (1996) discover that the temporary concealment of large trades details is not (or only in part) exploited by market-makers to protect themselves against inventory risk.

In particular, they observe that dealers take 45 out of 90 minutes³⁶ to get rid of the surplus inventory by trading with customers or other market-makers³⁷. Within that time frame just less than half of volume of block trades is unwound. This provides evidence of the fact that what market-makers look after is not the trade size of the single transaction but the cumulative

³⁵ Gemmill(1996) uses as sample period the time span from 1987 to 1992.

³⁶ Board *et al.* (1996) conduct their empirical analysis for the period 1 April 1992 – 31 March 1994.

³⁷ Trades between market makers can take place either through Stock Exchange Automated Quotation (SEAQ) system or Inter-Dealer Broker system.

While latter system is characterized by anonymity of trading, the former is not.

amount of inventory. The latter finding is further confirmed by the absence of a relationship between size and traded bid-ask spreads.

The absence of such a nexus may indicate that the main reason for which delayed publication of large trades was introduced reveals unrealistic. Alternatively, it may signal that deferred disclosure is actually useful because it allows market-makers to avoid quoting wider spreads to offset the greater inventory risk.

The authors find that deferred disclosure leads to informational inefficiency because the permanent price impact of block trades takes long to establish.

Board *et al.* conclude their study by acknowledging that the *reduction in transparency may not trigger any benefit* to market makers undertaking large trades.

Another proof of the lack of a trade-off between post-trade transparency and market quality is provided by Board *et al.* (2000) who analyse the transparency enhancement, which took place in LSE in 1996.

As mentioned earlier, the length of delay was shortened by 30 minutes (from 90 to 60 minutes), and the size above which trades were considered large was raised from 3 to 6 times NMS. This rule change permitted to reduce the amount of trading subject to temporary concealment by 43% and to overcome the threshold of 75% of the value of trading immediately disclosed for block trades.

To verify the success of the new post-trade transparency regime in improving market quality, the authors focus their attention on trades whose size is in between 3 and 6 x NMS. The year 1996 proved to be a turning point for such trades: they switched from the 90 minute delay rule to the immediate publication rule.

Contrary to what market-makers sustain, volume of the concerned trades didn't fall and the bid-ask spread even tightened. Thus, no losses in liquidity arose from the fast release of details about intermediate sized trades. I

In addition, market-makers behaviour didn't change: neither pre- nor post-positioning³⁸ showed significantly different patterns. Also the volume of inter market-maker trading remained almost the same.

In sum, the empirical literature gives evidence of what London Stock exchange stated in 1987: *“the faster is information disseminated to the market at large, the better”*.

³⁸ By pre- and post-positioning we mean how market-makers manage their inventory, respectively before and after a large trade is accommodated. More specifically, they measure by how much and how long it takes to change the level of inventory prior to or following a block transaction.

Chapter II
**A FOCUS ON ANONYMITY:
IS THE DISCLOSURE OF BROKER ID CODES GOOD FOR THE
MARKET?**

2.1 Preface

The increasingly automation of floor-traded equity markets has led to the progressive removal of broker identification codes. This trend was followed almost worldwide with the notable exception of Korean Exchange.

The driving force behind this revolution was the common belief among regulators of enhanced market quality. This issue has been long debated by academics, which reach mixed conclusions about the potential implications of broker identifiers concealment.

This chapter is organized as follows. Section 2.2 makes an excursus of the recent reforms undertaken by stock exchanges around the world in the dissemination of traders' identity.

Section 2.3 illustrates the strand of the literature investing the informational value of broker identities. Section 2.4 provides a complete overview of academics' findings about market quality implications classifying research papers according to the type of information investigated. Finally, section 2.5 draws some conclusions.

2.2 Anonymity: a world tendency

At the turn of the 21st century trading rules in equity markets around the world underwent changes. The field of regulatory intervention covered one of the dimensions of transparency: anonymity.

The majority of European stock exchanges have opted for the concealment of broker identities both before and after the execution of the transaction. The pioneer of the trend toward anonymity was London Stock Exchange, which introduced the choice of a central counterparty (CCP) for electronic equity trading (SETS and SETSqx markets) in February 2001. Since CCP acts as a buyer for every seller and as a seller for every buyer, after trade counterparties' identity has become no more visible. Given the already existing pre-trade anonymity, trading has turned out to be entirely anonymous. Nevertheless, at that time SETS was an electronic order-driven system that guaranteed one of the higher (if not the highest) level of both pre- and post-trade transparency of the limit order book among the main stock markets.

The example of LSE was followed by Euronext Paris in April 2001. In occasion of the merge with Amsterdam Stock Exchange and Brussels Stock Exchange, Paris Bourse started not to disseminate ID codes of broker-dealers entering limit orders to the book. Not only pre- but also post-trade anonymity was introduced: counterparty identity remained unknown even after the execution of the transaction.³⁹

This rule change was implemented by the French stock exchange in order to conform its trading protocols to the ones of the other two equity markets forming Euronext.

In 2003 Deutsche Börse AG, like the LSE, launched in a two-step approach a CCP for equities traded on the Frankfurt Stock Exchange.

The FSE is the most liquid⁴⁰ of Germany's seven stock exchanges and one of largest trading venue in the world. It is a hybrid market, which combines the fully electronic trading system XETRA with Frankfurter Wertpapierbörse floor⁴¹. As XETRA trading has always been pre-trade anonymous (i.e. market participants submitting orders are unknown), following the introduction of a CCP, anonymity applies also to the clearing and settlement processes. Despite the complete concealment of counterparty identity, XETRA provides both pre- and

³⁹ Actually, before April 2001 post-trade anonymity was applied to transactions in CAC40 stocks, which are the most liquid and largest shares listed on Euronext Paris.

⁴⁰ As reported by Deutsche Börse's official website, the share in turnover in Frankfurt Stock Exchange is larger than 85%.

⁴¹ In 2011 floor trading switched to Xetra technology (Xetra Frankfurt Specialist Trading). Nowadays, in fact, specialists, who offer quotes and oversee executed trades, assist floor trading. Xetra platform performs a mere price determination function. This change was implemented with the attempt to increase the speed of trading, to make FSE's scope international and to enhance liquidity provision.

post-trade transparency: market participants can observe the entire order-book and prices and volume of executed transactions are disseminated in real-time.

Exemptions to the general trend are Northern European countries. In fact, in April 2009 Nasdaq OMX Nordic⁴² removed post-trade anonymity introduced in the previous year for the five most traded shares on Stockholm market and restricted it to the five largest shares listed in Helsinki. Copenhagen exchange has continued to disclose member identity, whereas Reykjavik (Iceland) market has not.

While harmonizing EU Member States in terms of pre- and post-trade transparency, MiFID I directive doesn't enumerate broker identity among the pieces of information to be made available to the public.

As far as Asian markets are concerned, the least anonymous trading takes place on the Korean Exchange. Since 25 October 1999, the identities of the five largest buyer and seller brokers for each stock have been disclosed instantaneously not only in the Korean Stock Exchange and the Korea future exchange but also in KOSDAQ stock market. By contrast, Tokyo (from June 2003), Singapore, Taiwan markets provide fully unidentified order book.

Also American exchanges are aligned in offering complete anonymity to traders. Two interesting cases are worth mentioning: Toronto Stock Exchange and Nasdaq. These markets stand out from the rest because they leave the implementation of full anonymity to trading participant's discretion. In fact, traders, when submitting an order, can either designate attribution i.e. the market participant's identifier will be made visible in all market data feeds or require a generic code ("001" in the case of TSX and "SIZE" in the case of Nasdaq) to be attached to the order for its entire life cycle, even after fulfillment⁴³.

Anyway, in the case of unattributed orders, trader identity will be disclosed to the entity entitled to facilitate settlement of accounts (National Securities Clearing Corporation or the Canadian Depository for Securities Limited) at the end of each trading day.

Finally, in 2005 and 2007 the Australian and New Zealand Stock Exchanges were among the last equity markets to switch to anonymous regime.

Before 2005, in the ASX each broker could observe the identifier of brokers submitting orders to the central limit order book. Access to such information was, instead, denied to any other market participant. Nevertheless, this ban on broker ID dissemination was systematically circumvented by large institutional investors who obtained insights from their brokers.

⁴²Nasdaq OMX Nordic operates four Nordic stock exchanges: Nasdaq Copenhagen, Nasdaq Helsinki, Nasdaq Stockholm and Nasdaq Iceland.

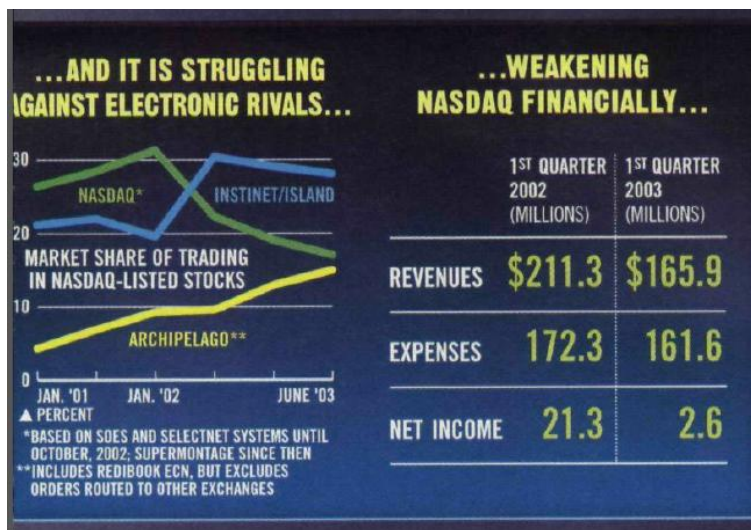
⁴³The Toronto Stock Exchange offers traders another possibility to disguise their identity: the submission of "jitney orders". By means of "jitney orders", a broker executes order flow routed by another. The name of the originating broker is concealed to the market.

They, therefore, enjoyed information privileges compared to individual investors. Following the rule change, broker identities have been kept secret (the standard code “777-7” is attached) for 3 days after trade execution. The ASX market reform, however, undermined the attractiveness of New Zealand Stock Exchange: many cross-listed stocks on NZX started to be traded in the anonymous Australian platform.

This was one of the reasons that forced NZX to align with the global trend.

The anonymity revolution has been mainly driven by the necessity of traditional stock exchanges to fight the battle for market share against Alternative Trading Systems. For

Figure 2.1. Source: BusinessWeek - August 11, 2003



instance, in the years preceding the introduction of SuperMontage post-trade anonymity feature, Nasdaq had been losing ground to Electronic Communication Networks (see figure 2.1). An ECN is an electronic trading platform that facilitates trading among its subscribers: retail investors, institutional investors, market makers and other broker-

dealers. In other words, it is an open limit order book where buyers and sellers can display their trading interest bypassing established exchanges. The first alternative trading system to be developed was Instinet in 1969. Instinet was created to enable institutional investors to have their trades executed. In the years that followed, several new ECNs proliferated (like Brut, Archipelago and Island) until the beginning of the millennium when as many as twelve ECNs were operative. At that time, off-exchange systems were drying up a significant portion of Nasdaq volume and their competitive advantage relied on four factors:

- i. *Full anonymity*: subscribers entering an order will never know with whom they traded. Indeed, in the execution report the ECN results to be the counterparty of the trade. By contrast, until 2003, SuperMontage granted only pre-trade anonymity.
- ii. *Small transaction costs*, since ECNs rely on computer software to bring buyers and sellers together.
- iii. *Order display options*: ECN subscribers can choose among a wide range of tools to communicate their trading interest, including pegged and discretionary orders. The former are orders whose price will track a benchmark price: the NBBO. The latter,

instead, are orders whose price is made up of two elements: a displayed price and a hidden discretionary price. The discretionary price consists of undisclosed upward adjustment in the case of buy orders and downward adjustment in the case of sell orders. The order will execute if on the other side an order priced inside the discretionary range is entered.

10. *Rebates*: ECN grants rebates to liquidity providers in order to attract trading volume. Therefore, with the attempt to increase the attractiveness of SuperMontage, Nasdaq has started to offer ECN-like services and in December 2005 it acquired Instinet.

Assessing whether the decision to restrict transparency by means of broker IDs concealment has proved panacea for the quality of the concerned equity markets is the objective of many research papers.

The analysis of the results obtained by the most important academic studies on anonymity will be the subject of the next paragraphs.

2.3 Broker identities: a conveyor of information to market participants

As previously mentioned, many exchange officials around the world have chosen to prevent the market from recognizing trading patterns linked with specific broker mnemonics. Two questions arise: does this impediment imply that broker identity has no informational value and therefore it is not worth displaying? Or if it really conveys information, does ID code revelation damage a particular class of investors?

One important strand of literature states that broker identifiers do provide insights additional to information already disseminated through pre- and post-trade transparency.

Frino *et al.* (2010) survey the Australian Stock Exchange in the pre-reform period (between January 1, 2001 and December 30, 2003) when participants entering orders to the electronic open limit order book, SEAT, were easily identifiable.

They report that trades executed in a raw and on the same side by the same broker significantly move prices.

This is particularly true for medium sized transactions, confirming the prediction of the stealth-trading hypothesis. According to this conjecture, informed investors (mainly institutions) split large orders into smaller ones (the size should not be too small because of high trading costs) in order to exploit their informational advantage for long.

In addition, the permanent readjustment of the stock value is stronger at the opening of the trading day (first 30 minutes) than at the closing. Indeed, during this time frame adverse

selection costs are relatively high. Therefore, paired unidirectional transactions by the same broker are more informative in an environment with higher information asymmetry.

Thus, the observation of the order source and the order itself enables to *infer the information profile of the investor behind the agent*.

The same conclusion is reached by Linnainmaa and Saar (2012) who find that in a non-anonymous order-driven market, like Helsinki Stock Exchange, market participants are able to identify almost certainly the brokers' orders to front-run or mimic. Indeed, transactions executed by brokers whose client base consists mainly of domestic institutions and foreigners (assumed to be relatively informed) induce a higher permanent stock price change than orders submitted by brokers who act prevalently on behalf of households (postulated to be uninformed). Broker identity succeeds in delivering insights about the originating investor, although the tendency of institutions to disguise their presence through a number of brokers.

Actually, Goldstein *et al.* (2009)'s study of brokerage industry highlights that institutions, in particular the small ones, route their order flow to a limited circle of brokers.

This kind of investors need to strike a balance between concealing their trading pattern by distributing volume among as many agents as possible and becoming premium clients via order flow bunching.

The desire to benefit from special services like research, capital provision, expertise in trade facilitation, IPO allocation induces small institutions to bear higher per-share commissions and to have higher turnover. Only in this way they can have some possibilities to be first in some brokers' size rank. Therefore, small institutions are willing to partially expose their trading strategy as long as they receive premium attention from a few brokers.

Despite fierce competition from alternative trading platforms like Liquidnet, UNX, and ITG, which have pushed down average commissions, traditional full-service brokers continue to keep substantial market share in the institutional business.

Another evidence of the fact that publishing brokers' name increases the chances for market participants to correctly detect client's trading motives is adduced by Lecce *et al.* (2006). Their findings reveal that, when there are no information asymmetries, uninformed traders are not much concerned about anonymity. When, instead, an information event (like a takeover announcement) is going to happen, trader identifiers, if shown, allow uninformed traders, followers and dealers to *disentangle the information-driven component of order flow from the liquidity-motivated one*.

Since only informed traders know about the occurrence of a takeover announcement, the trading activity right before the event is attributable to them. Lecce *et al.* (2006) consider the

heterogeneity in the allocation of the permanent price impact among brokers as a proxy of the informational content that the market attaches to trades. The authors discover that the switch of Australia Stock Exchange to anonymous trading has led to a homogenization of permanent price changes across broker initiated trades, especially the block ones (the standard deviation of the mean price impact falls by 0,87% for all trades and by 2,85% for large transactions). This result suggests that, in the period preceding a takeover announcement, displaying broker ID codes conveys valuable signals for the detection of informed investors.

On the same wavelength, Waisburd (2003) states that in less anonymous markets effective spread is tighter. This reflects lower adverse selection costs, since in a transparent environment insiders' informational advantage is not sustainable.

No significant change is, instead, found for inventory control costs, contrary to exchange officials' expectation of an increase. Exchange officials assert that, when identities are revealed, liquidity providers face serious problems in getting rid of their inventory positions at a profit.

Thus, the conclusion that Waisburd reaches on the Paris Bourse is similar to what other studies highlight: *“broker's identity confers information regarding the nature of the order flow that he represents”*.

The inference-making ability of market participants implies certain knowledge of brokerage client base.

On the NYSE trading floor^{44,45} specialists trade repeatedly with a small set of identifiable floor-brokers. In order to reduce the cost of asymmetric information, specialists force brokers to signal information-driven trades and punish those who don't.

The penalizations may include the provision of less attractive quotes and the impossibility to access to valuable services like trade facilitation and the provision of market information. The longstanding professional relationship that specialists establish with the relatively small community of floor-brokers increases the likelihood for the transgressor exchange members to be recognized ex-post and punished.

In this way, brokers are induced to share their information and so to reveal trading motives behind their trades. As a consequence, specialists can clearly identify liquidity-motivated traders and charge them a tighter bid-ask spread.

⁴⁴The bulk of NYSE trading volume isn't routed via SuperDot system but through floor-brokers. Thus, block trades, which might be drawn by private information, are mainly negotiated on the floor.

⁴⁵On the NYSE floor the identity of brokers forming the trading crowd is visible to specialists.

Also informed traders will enjoy better terms of trade if the reduction in trading costs incurred by uninformed investors stimulates the volume of liquidity trading and therefore specialists' turnover.

By encouraging the trading community to cooperate for the public good, specialists are able to price protect themselves on the basis of the observable broker mnemonics.

Even when trading doesn't take place vis-à-vis, specialists can trace out the trade originator.

Indeed, the display book screen placed at specialists' trading post shows in real time all the data that are necessary for execution of orders submitted through SuperDot order routing system. Besides direction, size, type (market/limit) and price (should the order be limit), the specialists can read the identity of the issuing member, unless the order is unattributed.

The prolonged observation of the trading strategy associated with each specific identification code enables specialists to infer the trader type behind brokers' orders.

Chakravarty (2001) mentions, as one of the reasons why specialists might be interested in knowing with whom they trade, the fact that insiders' trades could be emulated by other investors and this could seriously damage specialists' profitability.

By contrast to what most academics state, Lepone and Mistry (2011) find that, in a contest in which hidden limit orders are allowed, broker identifiers don't provide further information than what is conveyed by undisclosed limit orders for the first 10 minutes after submission.

In the Australian Stock Exchange, the ULOs regime applies to orders exceeding 200.000\$.

This regime implies the concealment of the order quantity on the central limit order book: a generic "/u" is reported instead of the size indication.

The authors discover that, irrespectively of the broker identification regime, the submission of undisclosed limit orders, and in particular those aggressively priced, produces on average a stronger short-term price change than disclosed limit orders. This may indicate that current prices don't incorporate a new information event.

In sum, even if with some marginal exceptions, the majority of empirical researches conclude that *anonymity* leads to a *reduction in price efficiency*: informed investors are less likely to be noticed and thus less information is impounded into prices.

Yet, anonymity prevents market participants to link the market impact of an order to the issuing broker's fame.

After all is said and done, *broker identity* coupled with pre- and post-trade transparency enables to form *more precise guesses about motivation driving trades*.

2.4 Is the removal of broker identification beneficial for the market? Who benefits the most?

The anonymity literature is very broad and varied. It encompassed studies relying on:

- theoretical/empirical models;
- quote-driven/order-driven/hybrid markets;
- once-off regulatory intervention altering broker identity disclosure/comparison of parallel markets which differ in the degree of anonymity;
- disclosure or concealment of liquidity providers/demanders' identity.

According to me, the most effective way to conduct the concerned literature review is classifying academic papers based on whether they survey a change in the dissemination of pre-trade, post-trade or both pre- and post-trade ID information.

2.4.1 Pre-trade information about broker identifiers and market quality.

The investigation of the issue at hand should start from the illustration of some enlightening theoretical studies. Although surveys of this type are, more often than not, unable to replicate the actual traders' behavior and the conjectures on which they rely are often unrealistic, their findings are used by much of the empirical literature to corroborate its results.

Rindi (2008) envisions a *centralized, order-driven market* where risk-averse informed and uninformed traders supply liquidity to noise traders.

The informed market participants can act either on exogenously acquired information, the so-called insiders, or on endogenous costly information released by analysts. Two different trader identity disclosure systems are considered: anonymous and transparent trading regimes. In the market where trading occurs anonymously neither order volume nor trader ID mnemonics are disseminated. Thus, uninformed traders revise their expectations about the future asset value on the basis of the signal extracted from the market clearing price.

This signal, however, is biased because under anonymity uninformed traders are not able to establish whether the price impact has been produced by a liquidity imbalance, hedging activity of informed trades or by insider trading.

Under transparency, market participants have access to order flow, *traders' identification* and market price information. In a *transparent regime*, uninformed traders learn from informed traders' demand and become "quasi-informed": the adverse selection and risk-bearing costs are consequently mitigated. They are able to identify liquidity traders and, therefore, they are willing to accommodate their demand.

The impact of a noise trader's order is softened, signaling an *increase in liquidity*. This result is obtained provided that the number of informed/insider traders is given, that is, *insider trading regulation is easily circumvented*.

When, instead, *insider trading is effectively restricted*, the number of informed agents is endogenously determined and *transparency ultimately worsens liquidity*. Since information rapidly leaks out, its (costly) acquisition is no more convenient and informed traders are forced to exit the market. Given that informed agents are the most efficient liquidity providers, the negative effect on liquidity outweighs the positive impact arising from “quasi-informed” uninformed traders.

Besides liquidity, Rindi (2008) investigates other two market quality proxies: informational efficiency and volatility.

Informational efficiency (measured as the inverse of the variance of the liquidation value of the asset conditional on the signal extracted from the price) *is greater under transparency*, provided that insider trading is not effectively banned. This is due to a reduction in the uncertainty about the future value of the asset as the equilibrium price conveys a more accurate signal.

Less clear are the effects of transparency on volatility, which is expressed as a function of a price impact indicator, the variance of informed traders' signal, endowment shocks⁴⁶ and noise. Volatility can either rise as a result of more informative uninformed traders' orders or fall because transparency reduces the price impact of noise traders' orders. The prevailing effect is contingent on the parameter specification.

However, the author highlights that the more uninformed traders in a market, the higher the odds that transparency will exacerbate volatility. These findings are predicated on the assumption that the number of informed traders is constant.

Rindi (2008) concludes its study about pre-trade transparency with the analysis of the potential impact at the market participant level.

When information acquisition is exogenous, both noise and uninformed traders' welfare is positively affected, while informed traders incur losses. By contrast, when information acquisition is endogenous, only uninformed traders enjoy transparency. While informed investors are bound to exit the market, noise traders suffer from liquidity drain.

In sum, *pre-trade disclosure of trader identity and order-flow always benefits uninformed investors and damages informed ones* when acting as liquidity providers.

⁴⁶Endowment shocks produce a form of noise that informed traders use to hedge against the risk of information leakage in a transparent environment.

Madhavan (1996) constructs a similar model to Rindi (2008): *an auction market* where risk-averse strategic traders can submit either limit or market orders, cleared at a single market price. Like Rindi (2008), the author sets off a transparent trading mechanism against an opaque, fully anonymous regime.

In this framework, however, transparency doesn't imply indiscriminate pre-trade publication of the entire order-flow but only of the price insensitive (liquidity-motivated) component. In particular, the market has access to information about order imbalances which can originate from: derivatives expiration, the amassment of small retail orders submitted via electronic order routing systems or large aggressive orders of uninformed traders who opt for sunshine trading. The concept of pre-trade transparency used by Madhavan (1996) embraces both trader identity disclosure and open limit order book.

Besides liquidity traders, the market is populated by speculators/market makers whose reason for trade is either information about the fundamental value of the asset or portfolio hedging.

One aspect that is important to mention is that each market participant considers other trader's strategies when deciding the utility maximizing tactic to pursue.

The author's findings debunk the conventional wisdom that the *disclosure of pre-trade information* generally enhances market quality. Madhavan, in fact, discovers that it can make traders more reluctant to share their information with the rest of the market and therefore more likely to refrain from trading.

In other words, transparency can lead to a sort of *market failure*.

As far as volatility and liquidity are concerned, the dissemination of information (including broker identifier) on a pre-trade basis produces mixed results. On the one hand, speculative traders dampen temporary shocks by satisfying price insensitive traders' demand.

On the other hand, they magnify the impact of order imbalances by making their strategy less reactive to price changes. In addition, speculative traders reduce their demand of portfolio hedging, increasing the precision of forecasts about the fundament value of the asset and mitigating volatility.

Nevertheless, the author succeeds in identifying two cases in which one of the two effects prevails. In highly *competitive* markets, *transparency* does *mitigate volatility and boost liquidity*. In sufficiently *thin* markets, instead, noise reduction increases the effect of asymmetric information, thereby *exacerbating price volatility and worsening liquidity*.

While the impacts on volatility and liquidity are not always clear, pre-trade *transparency* unambiguously *increases price informativeness*.

Thus, Madhavan (1996)'s theoretical research sheds light on the reasons why:

- Floor-based systems are the typical “habitat” of active securities, while inactive stocks are often traded in anonymous limit order book systems;
- The benefits of communicating the uninformed status may not be sufficient in inducing liquidity traders to engage in sunshine trading. In thin markets, pre-announcing liquidity trading intentions implies higher execution costs compared to non-disclosure. This is because of greater price instability that comes with uninformed traders’ revelation. The instability signals the expectation that the asset value will be significantly different from trade price.
- Circuit breakers, temporarily shutting down trading in the event of a large order imbalance, may not produce the desired effect of better quality execution prices and mitigated volatility.

Another theoretical model is developed by Benveniste *et al.* (2003) who consider a *non-anonymous* exchange where a risk-neutral specialist acts as the counterparty of every trade. More specifically, he takes the other side of market orders submitted by brokers on behalf of their customers. Brokers’ clients may be informed or uninformed.

The ongoing dealings with the broker community allow the specialist to identify which members usually represent liquidity traders and which, instead, act as agents of privately informed investors. The result is reduced asymmetric information.

The specialist exploits its identification ability to price discriminate: brokers that in the past behaved as informed are charged a wide bid-ask spread, while brokers reputed to be *uninformed* are granted *price improvements*.

Besides disadvantageous trade terms, brokers discovered to act on the basis of private information are subject to severe sanctions by the specialist. These punishments leads to *greater information efficiency* as non-cooperative brokers are encouraged to reveal their informative status. Finally, provided that the elasticity of liquidity traders to transaction costs is high, *informed* traders enjoy an *increase in welfare* too.

Thus, Benveniste *et al.* (2003) sustain the superiority of (non-anonymous) floor-based trading system versus electronic anonymous system.

The analysis of the main theoretical literature strands enables us to conclude that:

- In quote driven markets, pre-trade dissemination of traders’ identity makes prices more informative about the fundamental value of an asset and can improve all traders’ welfare;

- In order-driven markets, either the effectiveness of insider trading rules or the degree of competitiveness in a market plays a dominant role in shaping the effects of pre-trade (ID and LOB) transparency on market quality proxies.

In the first case uninformed traders and informed traders always profit and lose, respectively. In the second, instead, liquidity traders may not always benefit from sunshine trading;

Many researchers don't base their results on conjectured markets but they use observed data to test specific hypothesis.

Their goal is to capture the real world complexity that theory is not able to model.

Some of those academics are Foucault *et al.* (2007) who empirically study the consequences of concealing liquidity providers' identity prior to trading in an *electronic order-driven market*. Their unit of analysis is the Euronext Paris and, in particular, CAC40 stocks which, despite other shares, experienced a pure shift toward pre-trade anonymity.

In fact, before 23 April 2001 (the regulatory intervention day), trading these securities has always been post-trade anonymous.

This empirical study aims at assessing the impact of anonymity on market liquidity and on the information content of the limit order book. The starting point is the intuition that limit order book provides insights on future volatility. This information, in fact, provides the basis for the pricing decision of limit order traders. The higher the expected future volatility is, the less aggressive limit orders should be: in this way, speculators are prevented from exercising incorporated free options when limit orders have become stale.

This logic would imply the ability of bid-ask spread size to reveal the magnitude of future price changes. The evidence corroborates this hypothesis.

The model, that Foucault *et al.* (2007) employ to conduct their study, envisions four types of traders: on the supply side, pre-committed and value traders; on the demand side, speculators and liquidity traders.

The authors distinguish two situations: value traders (also called dealers) possessing asymmetric/symmetric information about future price changes.

Under *asymmetric information*, both informed and uninformed dealers provide liquidity. Limit orders are posted during two subsequent phases: first, pre-committed and informed value traders, then uninformed dealers.

In the non-anonymous setting, the leader's identity is known to the follower who acquires volatility information by observing the limit order book. Under *anonymity*, uninformed dealers

are less able to detect trading motives of “first-stage” limit order traders. They, therefore, base their order submission strategy on *the odds that informed dealers are operating*.

If this probability is *low*, a wide bid-ask spread will not be sign of high future volatility and consequently of high risk of being picked off. This is because the *spread* is probably the result of *uninformative* quotes which will induce followers to post aggressive limit orders.

As a consequence, both quoted⁴⁷ and effective spreads⁴⁸ will tighten thereby *improving liquidity*.

By contrast, if informed dealers’ liquidity contribution is high, followers will be concerned about a wide bid-ask spread as it conveys a strong signal of a significant future price movement. Uninformed dealers’ reaction will be to reduce the amount of large and small, but, aggressively priced limit orders.

As a result, the introduction of anonymity will widen both quoted and effective spreads, although the tendency of informed value traders to enhance their aggressiveness⁴⁹. The final effect will be a reduction in liquidity.

When all dealers have equal access to volatility information, the follower will not obtain new insights about pending price changes from the observation of the book. Therefore, the switch to anonymity will not imply a change in the follower’s behavior, meaning that neither liquidity nor informational content of the limit order book will be affected.

The empirical research conducted on Euronext Paris shows that the concealment of broker identifiers led to a statistically significant reduction by nearly 0,02 euros in both quoted and effective spread and a weaker correlation between bid-ask spread and future volatility in the post-event period.

These results provide evidence in favor of the scenario envisioning asymmetrically informed value traders and low participation rate of informed dealers.

Comerton-Forde *et al.* (2005) draw on Foucault’s findings about Euronext and enlarge the scope of the analysis to Euronext 100 stocks. In addition, the authors study other two fully automated *order-driven markets*: Tokyo Stock Exchange and Korea Stock Exchange.

While the former removed broker id mnemonics alongside each limit order on June 30 2003, the latter started to reveal the names of the five largest brokers by trading volume in each stock on October 25 1999.

⁴⁷Foucault *et al.* (2007) compute a time-weighted quoted spread (or small trade spread).

⁴⁸The effective spread (or large trade spread) is computed as twice the absolute difference between the transaction price and the midpoint of the best bid and ask price five seconds before the transaction. The effective spread diverges from quoted spread when a marketable order walks up or down the book.

⁴⁹In non-anonymous markets, informed liquidity suppliers quote larger spread than necessary (bluffing) when they perceive a limited free option risk. The aim is to reduce expensive competition from uninformed value traders.

In line with Foucault's study, Euronext and Tokyo Stock Exchange witnessed a significant reduction of both the time-weighted relative bid-ask spread⁵⁰ and effective spread of orders⁵¹ (after controlling for stock price, trading volume and volatility) following the introduction of *pre-trade anonymity*. Thus, *liquidity increased* thereby enhancing market quality.

However, one aspect needs to be highlighted: the conclusions drawn for Tokyo Stock Exchange are not purely determined by a switch to pre-trade anonymity.

In fact, on June 30 2003 pre-trade transparency was extended by increasing the volume of orders disclosed by two price ticks.

As far as Korea Stock Exchange is concerned, wider post-event bid-ask spreads signal lower liquidity and, therefore, poorer market quality.

Finally, Theissen (2003) finds empirical evidence of the price improvement hypothesis modeled by Benveniste *et al.* (2003). The author investigates the floor of the Frankfurt Stock Exchange where trading takes place through the "*Makler*" whose role is comparable to those of NYSE specialist.

The research relies on the conjecture that non-anonymity (i.e. observation of brokers' identity before trade) provides the Makler with the ability of recognizing traders who are more likely to be informed. The specialist's inference ability may arise either from the analysis of counterparty's actions or from the reputation developed in past trading relationships.

The Makler, therefore, uses this knowledge to protect herself against the risk of adverse selection by offering the quoted spread to brokers servicing privately informed traders. Instead, brokers judged to act on behalf of uninformed investors enjoy more favorable trading conditions i.e. the inside spread.

However, price discrimination may also result from broker self-selection. When executing an information-driven transaction, two conflicting issues need to be addressed: compliance with the best execution duty and the preservation of a good reputation vis-à-vis the specialist.

In order to deal with this trade-off, the broker gives up obtaining price improvements for her informed clients and accepts the quoted spread. This "passive" behavior, however, is completely admissible in the sense that no breach of broker's agency obligations to her clients occurs. In this way, the broker earns a good credit with the Makler who will offer in exchange better-than-quoted terms on liquidity-motivated trades.

⁵⁰The relative bid-ask spread is equal to the bid-ask spread over the midquote. Foucault *et al.* use this measure of liquidity instead of the absolute bid-ask spread in order to avoid biases in the parameter estimates due to minimum tick size.

⁵¹The effective spread of orders allows for orders whose size exceeds quoted depth or which are granted price improvements. It is computed as the difference between the volume-weighted average price and the quote midpoint over the quote midpoint. This ratio is then multiplied for a coefficient taking value 1 for orders that walks up the book and -1 for orders that walks down the book.

Anyway, the source of price discrimination doesn't alter the hypotheses to test.

The first hypothesis postulates that favorable trade terms are explained by lower adverse selection costs and, therefore, don't deter Makler's profit. This view contrasts with Rhodes-Kropf (2001)'s market power model. According to these academics, price improvements are due to greater bargaining power of investors toward the specialist who witnesses a reduction in market making profitability.

The data on Frankfurt Stock Exchange confirm the first conjecture.

Thiessen (2003) discovers a negative non-linear relationship between price improvement, expressed in percentage terms of the quoted spread, and transaction size. This finding is consistent with the belief that large transactions are likely to be information motivated.

Not surprisingly, the extent of price improvement results to be positively correlated with the size of the quoted spread. The wider the spread quoted by the specialist in response to high adverse selection risk, the more advantageous the trading terms applied to the subsequent transaction if originated by an uninformed counterparty.

Thus, these results provide evidence of *information as one of the reason for specialist's price discrimination*. By contrast, Thiessen's empirical analysis rules out a market power explanation as it shows that the Makler's profit, measured as realized spread, is positively (instead of negatively) affected where price improvement is granted.

The second hypothesis relies on the presumption that the specialist offers the quoted spread to counterparties deemed privately informed and states that *transactions executed at the prevailing spread are supposed to move prices more than transaction executed at the inside spread*. The evidence supports this conjecture.

The ultimate conclusion that Thiessen reaches is that *the more susceptible a stock to adverse selection, the higher the benefits from non-anonymity*. It follows that the Floor should be the preferred trading platform of less liquid shares. This is exactly what happens in Frankfurt Stock Exchange.

In *anonymous* electronic trading systems, where adverse selection risk is particularly high, *uninformed investors are seriously damaged*.

2.4.2 Post-trade information about broker identifiers and market quality

To my knowledge, very few research papers isolate the effect of changes in post-trade broker identity disclosure regime on market quality. Yet, they all relate to electronic order-driven equity markets.

Friederich *et al.* (2011)'s empirical study belongs to this strand of literature.

These authors consider the once-off regulatory intervention, which took place in London Stock Exchange in February 2001. That month passed through the annals of the LSE's history for the introduction of a central counterparty in the electronic equity trading platform SETS.

Until then, only pre-trade anonymity has been guaranteed. Following the rule change, *traders' identities were hidden even after execution*.

At the outset of their investigation, Friederich *et al.* distinguish two theoretical views explaining the potential effects of anonymity on liquidity.

The first is the asymmetric information theory, which yields conflicting results.

On the one hand, under exogenous information acquisition, liquidity is negatively affected by post-trade anonymity, as it emphasizes the adverse selection problem (Huddart *et al.*, 2001).

On the other, under endogenous information procurement, liquidity and informational efficiency are boosted by counterparty identity concealment, since traders are encouraged to collect new information (Rindi, 2008).

The second theory, instead, relies on order anticipation arguments.

Order anticipation strategies are based on the exploitation of order flow data to detect a pending large order and consist in either front-running or adjusting quotes adversely for investors. Therefore, order anticipators are not interested in understanding the motivation driving trades but they need to know about the existence of an order capable of exerting a significant price pressure.

The anticipated trader is penalized in terms of higher execution costs.

In a post-trade non-anonymous market, traders with large market share and frequently trading on the same side are the most susceptible to order anticipation. In order to reduce such a risk, they increase the aggressiveness and the speed of execution and switch to the demand side.

As a consequence, spreads widen and the book becomes thinner.

By contrast, under anonymity, large traders are less likely to be anticipated and, therefore, engage in more patient execution leading to abundant liquidity.

Friederich *et al.*'s empirical study highlights a reduction of almost 20% in inside spread at the best and fifth limit price and an increase in the cumulative depth up to the fifth best price.

These findings signal a *liquidity improvement* and, consequently, do not provide support to Huddart *et al.*'s thesis.

Furthermore, small (with high information asymmetries) and high concentration stocks witness the largest increase in liquidity under anonymity. This is inconsistent with asymmetric information theories. In particular, Rindi (2008) predicts a reduction in liquidity for stock with large exogenous information asymmetries.

The inconsistency is further proved by the fact that neither a strengthening of asymmetric information nor a change in informational efficiency is observed after the switch to post-trade anonymity.

Strong *evidence* is, instead, found *for the order anticipation hypothesis*. As this theory postulates, the data show large broker-dealer order flow concentration and positive correlation in direction. In addition, small cap stocks (whose characteristics enable order anticipators to easily identify repeated traders) see greater liquidity improvements than large cap stocks under post-trade anonymity.

Another implication of the order anticipation theory is that anonymity should favor low depth stocks than high depth stocks, since the former are more likely to exert price pressure.

This pattern is confirmed in the data with a spread reduction of 20% in shares with the least depth. Finally, *large and repeatedly trading investors* (whatever their informational profile) enjoy the greatest welfare increase because of *the reduced market impact* that their trades produce, *when broker identifiers are concealed*. Lower, in fact, is the chance for order anticipation.

A peculiar investigation is conducted by Pham (2013) on the Korean Stock Exchange.

The uniqueness of this study stems from the examination of the implications on the Korean Stock Exchange when a *reduction in post-trade anonymity* occurs in another segment of the Korean Exchange⁵² i.e. the KOSAD Stock Market.

Prior to this rule change, only the trading protocol of the investigated market imposed real-time publication of the identities of the five most active (buy and sell) brokers, by cumulative trading volume, in every stock.

The aim of the study is to assess the impact on two specific market quality proxies: the permanent and transitory price impact of transactions. The permanent price effect captures the information content of trades and is measured as the signed difference between the quotation midpoint at the time of the trade and quotation midpoint in effect 30 minutes after the trade. The transitory price effect is the price change attributed to price pressure or liquidity costs and is estimated subtracting the current price to the quotation midpoint at the next trade.

The results show more informative buy and sell trades in the post-event period. Particularly, uninformed trades produce greater permanent price impact than informed ones.

Pham explains this finding using Rindi (2008)'s reasoning: the observation of broker identities enables *uninformed traders* to become "*quasi-informed*".

⁵² The Korean Exchange is partitioned into three segments: Korean Stock Exchange, KOSDAQ Stock Market and Korea Futures Market.

The homogenization of the transparency level throughout the Korean Exchange is argued to mitigate the migration of informed traders toward opaque segments of the exchange. As a consequence, *faster price discovery* is achieved in the Korean Stock Exchange.

As far as temporary price effect is concerned, no unambiguous conclusions can be derived. On the one hand a reduced impact is observed for sell trades (especially the informed ones), signaling an increase in liquidity. On the other, a greater transitory price change is recorded for buy trades after the regulatory event.

Thus, Pham concludes that revealing the identity of the five largest brokers post-trade has been a good choice in terms of *enhanced market efficiency*.

One last research isolating post-trade anonymity effects is performed by Hachmeister *et al.* (2010). They survey the electronic trading platform XETRA of the Frankfurt Stock Exchange around the implementation of the central counterparty system.

The direct consequence of such innovation is the *impossibility for traders to be identified post-trading*. Given that broker mnemonics were already unobservable alongside unexecuted orders, full anonymity was introduced.

To assess the potential market quality consequences of the new policy, Hachmeister *et al.* avail themselves of a unique indicator directly provided by Deutsche Börse AG: the XLM. The latter is an all-in-one parameter; it captures three dimensions of liquidity: market breadth (or width), market depth and immediacy in execution. The fourth dimension, resiliency, is still measurable via XLM but requires an observation of the parameter over time.

The mechanism, by which XLM proxies liquidity, relies on the concept of implicit transaction costs. Indeed, it consists in summing up the liquidity premium computed as half bid-ask spread and the adverse price movement expressed as the price impact of an order walking up or down the book. The result captures the round-trip cost of executing a given size order.

Besides liquidity, the authors want to investigate how informed trading in an instrument⁵³ is affected by the introduction of post-trade anonymity. To this end, they employ the EKOP model which estimates the probability of informed liquidity demanders to arrive in the market.

Both univariate and regression analysis provide evidence of *lower order book width* (i.e. a decline in liquidity premium by around 25%), *larger order book depth* (i.e. a decline in adverse price movement) and *enhanced overall liquidity* (i.e. a reduction in XLM).

Surprisingly, the share of informed trading is found to be negatively affected by the introduction of post-trade anonymity. This is inconsistent with what theoretical and empirical

⁵³ The results of empirical analysis are based on a sample of DAX 30 instruments. These instruments are very liquid and resemble CAC40 stocks.

literature predicts: informed traders are better off under anonymity, as it prevents costly, endogenously acquired information to rapidly leak out.

Such unexpected result may be due to the fact that EKOP model releases information about the arrival rate of liquidity takers and not liquidity providers.

The increase in overall liquidity and the unmodified information environment suggest that *informed traders might have changed their behavior by switching to the supply side*.

As Foucault *et al.* (2007) states, under anonymity, informed liquidity providers don't need to quote larger spread than appropriate in order to avoid free-riding by uninformed quote setters. This is why liquidity premium declines in the post-event period.

2.4.3 Pre-trade and post-trade information about broker identifiers and market quality.

For sake of completeness, I would like to conclude my literature review by mentioning the findings of a few academics who consider simultaneous implementations of pre- and post-trade anonymity in fully *electronic order driven markets*.

The Australian Stock Exchange's policy not to display brokers' names before and after trading is investigated both by Comerton-Forde *et al.* (2009) and Pham *et al.* (2013).

The authors, however, reach different conclusions.

From a market quality perspective, Comerton-Forde *et al.* (2009) support the rule change as it produced a tightening of time-weighted proportional bid-ask spread and a significant decline of the effective spread of orders. The latter result signals *deeper limit order book* and consequently lower price impact of large market orders after the shift to full anonymity.

Furthermore, a reduction in order aggressiveness is observed. This is explained by the fact that the concealment of broker ID codes prevents the recognition of motivations driving trades; thus, informed and uninformed trades are less exposed to the risk of being front-run and picked-off, respectively.

The stock by stock results show that *large and more active shares enjoy greater liquidity improvements* than small stocks, *following anonymity* implementation. Indeed, the decomposition of the effective half spread highlights smaller price impact component for liquid stocks, signaling lower adverse selection costs, and larger realized spread for illiquid shares. The latter finding is due to trader's reduced ability to communicate to the market their inventory adjustment needs, when trading occurs anonymously in stocks subject to severe adverse selection problems.

Comerton-Forde's study is particularly innovative because, besides the impact on traditional market quality proxies, it also investigates how the competition between downstairs and upstairs market is affected.

On the Australian Stock Exchange, a broker intermediated off-exchange market for block trades, portfolio special crossings and priority crossings operates parallel to the limit order book. The execution of a priority crossing requires prior display of orders in the main market at the crossing price for minimum 10 seconds.

Thus, the observation of broker identities in the book is fundamental for counterparty search, for private negotiation and also for the sustainability of the internalization activity offering protection against order exposure risk.

That's why, after the switch to anonymity, the downstairs market has started to attract more order flow than the non-anonymous upstairs market. In this case we talk about *liquidity consolidation*. Evidence of this phenomenon is also provided by an increase (although not significant) of Australian Stock Exchange's trading volume compared to the transparent New Zealand Stock Exchange. These findings hold for stocks with low adverse selection risk.

Anonymity, therefore, can affect investors' market selection decision and in a fragmented trading environment is used by exchanges to manage competition for large stocks and offer tighter spreads.

Comerton-Forde's results contrast with those of Pham *et al.* (2013) who discover that, after the removal of broker identities both pre- and post-trade, the limit order book loses order flow toward off-exchange markets and that the change in spread is negligible. This divergence may be due to the fact that Pham *et al.* use instrumental variables to deal with endogeneity and don't perform a stock by stock analysis.

In addition, the authors find that market efficiency is higher in a transparent environment i.e. stock prices take a random and unpredictable path.

Finally, I report the outcomes of a very interesting study conducted by Comerton-Forde *et al.* (2011) on Toronto Stock Exchange. The peculiarity of this empirical analysis comes from many aspects. First, the investigated market hasn't undergone any once-off policy change but it has always granted traders the possibility to submit unattributed (or anonymous) orders⁵⁴.

In other words, anonymity is not a regulators' choice but is the result of market participants' volition.

⁵⁴ These orders remain without broker attribution even in post-trade phases.

Second, the authors are the first to identify the factors influencing the anonymity decision. Broker type, order source, aggressiveness of order placement and spread size are its primary determinants.

As far as order source is concerned, agency brokers, who mainly trade on behalf of their clients, generally opt for anonymity when submitting non-core orders i.e. proprietary and non client orders. Dual traders, instead, are more likely to submit anonymous core orders i.e. proprietary and institutional orders. Finally, specialists⁵⁵ and option market makers prefer to use unattributed orders when performing the market making function.

Market makers generally conceal their identity when trading aggressively on the basis of short-lived information about future volatility⁵⁶. The combination of anonymity and aggressiveness is valuable to specialists also when they need to promptly alter their inventory position. By contrast, they prefer to reveal themselves to the market when acting as patient liquidity providers (their traditional function).

Agency and dual capacity brokers, instead, are less likely to attach ID attribution to non-aggressively priced orders. The motivation driving this choice is either long-run exploitation of an informational advantage or pick-off risk mitigation (in the case of non-urgent liquidity traders).

Lastly, spread size influences the anonymity decision of agency brokers and market makers. The larger the spread, the lower the willingness to advertise their names. Indeed, when information asymmetry is high, front-running and piggybacking by informed traders are more likely to occur. In such a circumstance, anonymity helps to prevent this from happening.

A third aspect that distinguishes this study from previous literature is the fact that a further consequence of anonymity (other than impossibility for the market to use broker mnemonics to infer the informational profile of investors) is considered.

In fact, random orders determine larger future price impacts, if submitted anonymously rather than non-anonymously. The difference in price impact ranges from 1 to 11 basis points.

This is because the use of anonymity may signal the presence of a trader for whom the non-attribution option is valuable: typically informed investors.

However, if *anonymity is the result of a strategic choice* (taken on the basis of order attributes, market conditions and unnoticeable features like information and trading strategy), traders will enjoy *lower execution costs* than in the case of attributed orders.

⁵⁵ On the Toronto Stock Exchange each listed firm has a designated specialist who makes the market in a fully electronic continuous auction system. This explains the hybrid nature of TSX.

⁵⁶ Specialists may have access to order flow information not yet publicly available. For example, they may have insights about the existence of pending orders, which are shopped in the upstairs market.

Only some TSX members succeed in taking advantage of strategic ID concealment: particularly, *market makers*. These traders, probably, have free access to anonymity and they may hold information or pursue a trading strategy whose success relies on the impossibility to be recognized by the market.

Brokers, instead, may encounter some restrictions in the submission of anonymous orders. Sometimes they must follow client's attribution requirements⁵⁷ or they desire to enjoy the advertising benefits arising from identity disclosure. This may explain the authors' finding that most of the traders decide to reveal themselves to the market, notwithstanding the option to conceal their identity.

As far as market quality is concerned, Comerton-Forde *et al.* (2011) argue that *anonymity doesn't deter liquidity under endogenous information acquisition*.

On the one hand, uninformed traders are reluctant to supply liquidity in anonymous environments, since these markets are likely to draw informed trading. On the other hand, informed traders are encouraged to look for additional fundamental information and, therefore, provide further liquidity. These two effects counter-balance each other.

In addition, *the effects of anonymity on informational efficiency are mixed*.

Since the strategic selection of anonymity mitigates price impact, it reduces the speed with which information is incorporated into prices and consequently market efficiency. Such a result holds *ceteris paribus* i.e. with unchanged number of informed traders, information environment and aggressiveness in order placement.

In the meantime, anonymity may lead to more informative prices:

- it may incentivize traders to collect more information about the fundamental value of assets and,
- it may induce informed investors to switch toward least transparent markets and to place aggressively priced orders

2.5 Concluding remarks

The entire literature relies on the fact that broker identities do have informational value: they allow to attach a greater probability of informed trading to some market participants.

Thus, the disclosure or concealment of broker mnemonics will affect traders' strategies and ultimately market quality. Despite acknowledging the fact that policy implications crucially

⁵⁷ The choice to submit attributed or unattributed orders can be made by either the broker or the client. Most of the times it's a broker determination.

depend on market-specific characteristics such as the amount of insider trading and the initial level of liquidity, I still try to draw some general conclusions about the potential impacts.

In dealer markets where trading is repetitive, non-anonymity improves market efficiency, since ex-post sanctions by the specialist will force informed traders to share their information advantage. Tighter bid-ask spread will be offered to uninformed traders, reflecting lower information asymmetries. Even brokers acting on behalf of informed traders may enjoy price improvements, should uninformed traders be very sensitive to transaction costs.

As far as order-driven markets are concerned, most academics conclude that concealing broker identifiers, either before or after trading, has a mixed impact on market quality.

On the one hand, it reduces the speed with which information is impounded into prices, lowering market efficiency. On the other hand, it tightens bid-ask spreads and enhances quoted depth, improving market liquidity.

Two different arguments are commonly used to justify increases in liquidity.

The first is the asymmetric information argument: disclosing the identities of brokers considered informed leads to information leakages. Their profits deteriorate and the incentives to engage in more fundamental research decrease in equilibrium. Under anonymity, informed liquidity suppliers quote more aggressively as there is less risk of uninformed traders free-riding on their information.

In limit order books where trading is concentrated among a few brokers, liquidity improvements are justified using order anticipation arguments: anonymity allows large repeat traders to produce smaller price impacts and to engage in more patient execution, since the chances to be exploited by order anticipators are greatly reduced.

Thus, uninformed traders may benefit from transparency reduction in a system with repeat trading and strategic counterparties, contrary to the common belief in microstructure literature that disclosing trading intentions is always panacea for uninformed market participants.

Innovations in financial regulation, such as the MiFID in Europe and the Regulation National Market System in the US, have created fragmentation, posing challenges to traditional stock markets. In fact, a variety of new trading venues have proliferated: electronic communication networks (ECNs), broker-dealer crossing networks, dark pools, and over-the-counter markets (OTC). In such a context, anonymity may help official markets in subtracting order flow, especially block trades and trading in large stocks, to off-exchange trading platforms.

The finding that anonymity can improve liquidity in electronic limit order books is not so surprising if we consider that such a result is obtained in markets with already high level of pre- and post-trade transparency. This is consistent with what stated by Matthias Levin,

former fellow of the Center for European Policy Studies: “*Overall, transparency is no panacea and there is ‘disquieting evidence’ that too much transparency may harm market quality, as it effectively disables some liquidity provision*”.

In the next chapter, I am going to conduct an empirical analysis on the market quality implications of the introduction of a central counterparty in the Italian Stock Exchange. My attempt is to test the conclusions about post-trade anonymity reached by Friederich *et al.* (2011) on LSE.

Chapter III

EMPIRICAL ANALYSIS OF THE INTRODUCTION OF POST-TRADE ANONYMITY ON “NUOVO MERCATO” OF BORSA ITALIANA.

3.1 Preface

The purpose of this chapter is to analyse how market liquidity was affected by the implementation in 2004 of post-trade anonymity in “Nuovo Mercato”, and what kind of arguments can explain this change.

This innovation involved also Mercato Telematico Azionario which, at the same time, underwent the introduction of order book anonymity. Thus, it was not possible to isolate the effect of concealing broker identification codes in the post-trading phases.

In Nuovo Mercato, instead, trading has been pre-trade anonymous since its creation in 1999.

My aim is to replicate the empirical study that Friederich and Payne (2011) conducted on the electronic equity trading platform SETS of London Stock Exchange.

The originality of my research stems from the fact that to my knowledge no one in literature identified the effects of post-trade anonymity on the Italian Stock Exchange.

The chapter is organized as follows. Section 3.2 explains why I decided to study Nuovo Mercato. Section 3.3 provides some institutional details. Section 3.4 provides information about the regulatory intervention. Section 3.5 reports the data set and the procedure leading to the creation of the treated and control samples. Section 3.6 is dedicated to the model specification. Section 3.7 contains the discussion of the main results. The chapter ends with some conclusions.

3.2 The research question: why Nuovo Mercato?

After the analysis of papers studying regulatory changes in transparency regime, I realized that few academics investigated the concealment or revelation of broker identities post-trade and that no one investigated Borsa Italiana's markets.

I found out that two stock markets, “Nuovo Mercato” and “Mercato Telematico azionario” underwent the introduction of post-trade anonymity in January 2004, following the implementation of a CCP system.

The reason why I chose to analyse Nuovo Mercato is because MTA experienced at the same time (on 21 January 2004) the launch of order book anonymity. Since then, the identification code of the intermediary entering an order to the trading book has been concealed.

Therefore, it was not possible to isolate the effect of post-trade anonymity on MTA's market quality. In Nuovo Mercato, instead, pre-trade anonymity has been continuously guaranteed since its creation in 1999.

More details about the regulatory intervention will be provided in section 3.4.

3.3 Institutional details

The origin of the market

Nuovo Mercato was launched in June 1999 and was designed for innovative and high growth companies. The creation of this new equity market in the Italian Stock Exchange followed a European trend that involved France with the Nouveau Marché, U.K. with the Alternative Investment Market and TechMARK, Germany with the Neuer Markt, the Netherlands with Nieuwe Markt and Spain with Nuevo Mercado. These NMs were designed having in mind the U.S. Nasdaq, whose purpose was to support financially start-up companies.

Since its birth, Nuovo Mercato had been part of the Euro.nm, the alliance among the new markets of Amsterdam, Brussel, Frankfurt and Paris Stock Exchanges. The admission and trading requirements were homogeneous across the members of the alliance and the intermediaries of one market could access to any of the other three markets by means of a common interface.

Firms listed on Nuovo Mercato operated in high-tech manufacturing, Internet, biotechnologies, telecommunications industries or in “conventional” businesses with product, process or logistics innovations.

Before the event, on 31 December 2003, 43 firms were listed and the market capitalization totalled 8,3 billion euro (1,7% of total capitalisation of equity markets). At the end of 2003 the average daily trading volume was around 56 million euro⁵⁸.

The end of the Nuovo Mercato Era

After the resounding success achieved at the debut, in 1999, and in the first months of 2000, the market underwent the negative effects of the burst of the Dot.com bubble, and gradually fell into the oblivion. As a consequence, in 2005, Borsa Italiana decided to stop Nuovo Mercato from operating and to create a new market, MTAX, with the same segmentation of MTA: Blue Chip (top-cap⁵⁹ firm), Star (medium-cap firm committing to achieve excellence) and Standard (for all other medium-cap⁶⁰ firms). This change came into effect on 19 September 2005 and followed the dismissal of Neuer Markt in Germany which took place 2 years earlier.

Requirements for admission to listing

Firms willing to quote on Nuovo Mercato had to comply with both formal and substantive requirements.

The formal prerequisites entailed:

- The publication and filing of financial statements for minimum one year;
- Venture capital institutional investors' ownership of at least 10% of the share capital, should the firm be operating for less than 3 years. This sine qua non, however, would not have been necessary if the firm arose from entity restructuring operations (mergers, spin-offs etc.) or if it was already listed on another regulated market;
- Net equity equal to or larger than 3 million euro;
- Free float held by the public or institutional investors not less than 30% of the share capital;
- An IPO of at least 5 million euro (at least 100.000 shares) of which 50% new issues;
- Lock-in clause relating to 80% of shares held in IPO for a year.

The substantive requirements, in turn, called for:

- Above average revenue growth;
- Consistent business plan;

⁵⁸ The data were published by Borsa Italiana in the BIStat report of December 2003.

⁵⁹ Top cap firms encompass companies with market capitalization larger than 1 bln euro.

⁶⁰ Medium-cap firms have a market capitalization in between 40 mln and 1 bln euro.

- Clear definition of the business model and of the competitive scenario;
- Skilled and motivated management team;
- The orientation toward value creation and communication (Investor Relator);
- Compliance with the Voluntary Self-Regulatory Code of listed companies.

The financial instruments admitted to trading included shares, warrants, option rights and convertible bonds.

Continuing requirements for listed companies

The permanence of firms on Nuovo Mercato called for the compliance with organizational and disclosure requirements.

From an organizational perspective, the issuing company was required to elect a Sponsor and a Specialist in the secondary market.

From a communication perspective, instead, every financial year, CONSOB, Borsa Italiana and the public were granted access to information concerning:

- The financial statements, directors and auditors' reports. These financial documents had to be made available from the day immediately after the approval of the annual financial statements;
- The semi-annual report which had to be released no later than four months after the closing of the first semester of the year;
- The quarterly reports. This duty was to be complied for by 45 days after the end of each quarter of the financial year.

Furthermore, the Specialist was required to publish two surveys on the issuing firm and to promote at least two meetings with the financial community.

Admitted intermediaries

The intermediaries admitted to operate in Nuovo Mercato were required to comply with listing and continuing requirements established by the “Regolamenti dei mercati di Borsa Italiana” and by the “Testo Unico della Finanza” (Legislative Decree No. 58 of 1998).

Under a law perspective, the admission application could be submitted by:

- Exchange brokers (only dealing on client's account);
- National, EU and extra-EU banks;
- National, EU and extra-EU investment firms;
- Locals with registered office in one of the EU Member States (only dealing for own account);


- Poste Italiane Spa, authorized by Presidential Decree 144 of 2001 to provide trade services on behalf of clients.

All intermediaries authorized to operate on the market actively took part to the price formation process with proprietary orders and/or clients' orders. The fairness of treatment was ensured by the market microstructure: orders were executed according to price and time priority which were the primary and secondary order precedence rules, respectively.

The market microstructure

Nuovo Mercato was an electronic order-driven screen-based market characterized by the mandatory presence of specialists. Specialists undertook to continuously quote bid and ask prices and to promote the dissemination of analyses on the issuers. They had to expose all orders until a minimum daily quantity was traded.

The specialist's liquidity commitments for the year 2004 are reported in figure 3.1.

 GRUPPO BORSA ITALIANA Le modalità di negoziazione

Il Nuovo Mercato - Il requisito di liquidità

IMPEGNI DI LIQUIDITÀ DEGLI OPERATORI SPECIALISTI

| PARAMETRO | OBBLIGHI SPECIALISTA (mercato diurno) | | | |
|-------------------|---------------------------------------|---------------------------------|--------|---------------------------------------|
| | Cvtl medio giorn. Scambi (euro) | Quantitativo giornaliero (euro) | Spread | Quantitativo per ogni proposta (euro) |
| Fino a 150.000 | | 20.000 | 4,0% | 2.000 |
| 150.000 - 500.000 | | 40.000 | 3,5% | 2.000 |
| Oltre 500.000 | | 80.000 | 3,0% | 2.000 |

* Per le obbligazioni convertibili, il quantitativo minimo giornaliero è lo stesso quantitativo stabilito per le azioni sottostanti; il differenziale massimo di prezzo (calcolato come rapporto tra la differenza del prezzo in vendita e del prezzo in acquisto e la loro semisomma) è fissato al 2%.
08.05.2004

Figure 3.1 Source: Toscani, D., Bosetti, L., "Struttura e funzionamento dei mercati azionari di Borsa Italiana", 8 May 2004

Intermediaries could enter limit orders, market orders and trading proposals at the auction price (PDN) along with validity conditions (VSC = valid till cancellation, VSD = valid till a specified trading day, VAC = valid in the closing auction only) and execution conditions (EEC = fill and kill, EQM = minimum execution size, TON = fill or kill, ECO = execute anyway and hidden limit orders). Trading proposals had to include at least the information concerning the financial instrument, the quantity, the trade direction (buy or sell), the account type (proprietary or client) and pricing conditions.

Market orders could be submitted as long as there was at least an opposite trading proposal with price limit.

The trading model entailed an opening auction (from 8:00 a.m. to 9:10 a.m.), continuous trading (from 9:10 a.m. to 5:25 p.m.) and a closing auction (from 5:25 p.m. to 5:40 p.m.). Trading could also take place after hours (TAH) in a continuous way from 6:00 p.m. to 8:30 p.m.. The execution of orders followed the price-time priority rule. Furthermore, a privilege of 5 minutes was granted to the specialist when trading institutional orders.

A trading suspension or an extension of the pre-auction phase occurred if the price violated specific parameters set out by the “Divisione Vigilanza Mercati” according to liquidity of the financial instrument, the information and the events potentially affecting price discovery.

These parameters were expressed as static or dynamic ranges centered on a benchmark price which was either the control price⁶¹ or the last trade price. A revision of these ranges took place in consideration of particular market trends.

As far as market transparency is concerned, intermediaries had real time access to the following information:

- In the pre-auction phases: reference price, control price, theoretical auction prices, overall tradable and non-tradable quantity at these theoretical prices;
- During continuous trading: the entire order book, a summary of trading terms for each financial instrument (trading parameters, market phase, reference price, control price, opening price, last trade price, the best ask price and the best bid price, total traded volume), a recap of their own arranged trades and of their trade proposals and, finally, a summary of the trades arranged on the market for every financial instrument.

The public, instead, was provided with the following data:

- In the pre-auction phases: the theoretical opening price and the relative available volume, the best bid and ask prices and the volume available at those prices, the control price and the quantity available at the 5 best price levels;
- During continuous trading: the best bid and ask prices and the volume available at those prices, the quantity available at the 5 best price levels, last trade price, time of the trade and relative traded volume, cumulative traded volume and value, control price.

Thus, Nuovo Mercato was characterized by high levels of both pre- and post-trade transparency. Since its birth, the identity of intermediaries placing orders to the trading book had been concealed. The impossibility to trace the origin of the order before the trade had been advocated as a means to strengthen market quality by enabling a more efficient price formation process.

⁶¹ The control price is the price guiding the automatic control of trading in order to ensure a regular and substantial price formation process.

Furthermore, the participation of intermediaries actively providing liquidity would have been stimulated. Until 26 January 2004, the date event, post trade-anonymity was not guaranteed.

3.4 The event

During 2003 Borsa Italiana Group implemented an important post-trading innovation aimed at strengthening the operating efficiency of financial markets. This innovation involved the introduction of a Central Counterparty (CCP) system, managed by Cassa di Compensazione e Garanzia (CC&G), in stock markets.

Before going into the details of this reform, I find it useful to briefly recall the security industry value chain with a particular focus on post-trading phases.

Following the execution of a trade (which takes place according to specific price and time priority rules), the netting and guarantee processes initiate, trade terms are matched in order to assess whether the buyer and the seller have agreed to the same conditions and, finally, contracts are cleared and settled.

A wider description of the trading stages with the specification of the actors involved is provided by Figure 3.2.

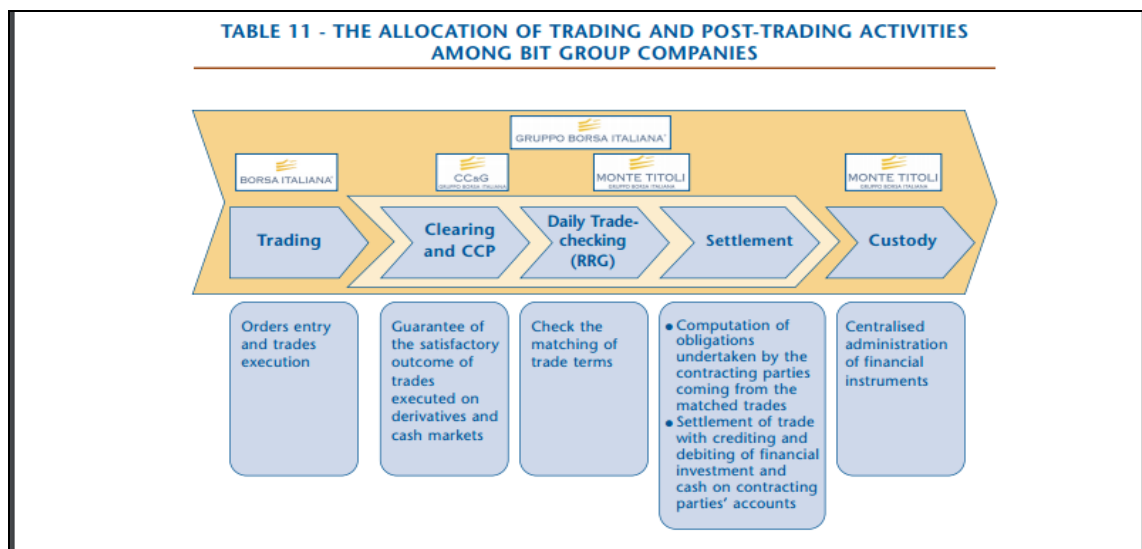


Figure 3.2 Source: Borsa Italiana's Facts and Figures 2003

Returning to the issue at hand, a Central Counterparty system has traditionally guaranteed derivatives contracts and, following 2003 reform, these guarantees have covered also cash equity markets.

The CCP places themselves between the buyer and the seller of an original trade and ensures the proper performance of the obligations under the contract, thereby eliminating the counterparty credit risk.

The CCP implementation concerned the Mercato Telematico Azionario (Electronic Share Market), the Nuovo Mercato and the respective Trading After Hours segments. This change occurred in two stages:

1. The very first step towards the new trading arrangement was made on 23 May 2003. It involved the confirmation that the obligations arising from the contracts introduced in the Daily Trade-Checking system (sistema di Riscontro e Rettifica Giornaliero) were guaranteed by the CCP. At that time, post-trade anonymity was not already introduced, since the bilateral balances provided to the settlement system remained identifiable.
2. The second and final phase, started on 26 January 2004, is the one in which the most dramatic changes were implemented.

Now, the CC&G results as the counterparty of every trade and, therefore, *bilateral balances* remain *anonymous* since the entering of the contract into the RRG system.

Furthermore, a process of flexibilization of the clearing and margining system was activated, enabling:

- Direct members of the guaranty system to participate indirectly to the settlement system;
- Indirect members of the guaranty system to directly join the settlement system;
- The possibility for direct participants to opt for the so-called “cross margining”, that is, a margining that combines cash and derivative positions;
- The possibility for direct participants to ask for the separate computation and payment of margins for each market.

The superiority of the CCP system over the old system based on mutual guarantee funds is proved by three main features. First, the margining methodologies are in line with the international best practices. Second, intermediaries are required to provide an amount of guarantees consistent with the risk they are exposed to. Third, the counterparty risk (unconstrained under the mutual guarantee funds system) is completely eliminated.

The CCP guarantee system relies on four pillars:

1. Membership requirements: the direct or indirect membership to CC&G is a prerequisite for trading on the markets where a CCP system operates. The direct participants must comply with specific organizational and capital parameters;

2. Margining system: members are required to provide collateral in an amount sufficient to fund the theoretical settlement costs that CC&G would incur in the worst case, should one of the participants default on outstanding contracts;
3. Default fund: in the case in which the initial margin set up by the defaulter is insufficient to meet the amount owed, the CCP can use the defaulter's quota of the default fund to cover the loss. All members must contribute to this fund prior to using the CCP;
4. Capital and financial resources: Should one of the direct members fail to perform its obligations, the CCP can draw on its own equity resources under certain circumstances and according to a precise sequence.

In the event of a Clearing Member default, the CCP has at its disposal a number of safeguards that shall be used in the following order:

1. Initial Margin of the defaulter
2. Defaulting participant's default fund contribution
3. Quota of CCP's capital up 5 million euro
4. Default fund quota of non-defaulting clearing members
5. Additional CCP capital quotas

The introduction of the Central Counterparty system was driven by the *general thinking* that it would have *boosted liquidity* by ensuring the safeness and the stability of the trading framework. The removal of the counterparty risk and the concealment of identities post-trade would have induced local intermediaries to enhance their trading activities and, at the same time, it would have drawn foreign operators.

3.5 The data

3.5.1 Data source

For each stock, daily trade and quote information was obtained from Thomson Reuters Datastream Database.

Unlike Friederich and Payne, I had access to very few intraday data and, thus, I used end-of day values instead of average values most of the times.

3.5.2 The sample period

The sample period includes fourteen months before (290 trading days) and six months after (129 trading days) January 26 2004, the event date. More specifically, I defined the pre-event period as the time interval from 1 November 2002 to 31 December 2003, and the post-event period as the time span between 1 February 2004 and the 31 July 2004.

I discarded the month of January 2004 since in that period some tests took place to assess the new trading procedure. Over the observation period no change in the level of pre- and post-trade transparency occurred. In fact, the MiFID I directive entered into force only 3 years later.

3.5.3 The main sample

The sample of stocks undergoing the introduction of post-trade anonymity (“treated sample”) is made up of 11 out of 43 stocks quoted on Nuovo Mercato during the sample period. The remaining stocks were not included because the database Datastream provided either no data at all or insufficient information to run the regressions necessary to conduct my analysis.

Table 3.1 – *The treated stocks*

| TREATED SAMPLE |
|---------------------|
| FASTWEB |
| TISCALI |
| CAIRO COMMUNICATION |
| ESPRINET |
| DATALOGIC |
| MONDO TV |
| CDC POINT |
| REPLY |
| DADA |
| EL.EN. |
| CAD IT |

The firms included in the sample operate in the technology and telecommunications industry and their average market values (computed over the sample period) range from around 67 million euro (EL.EN.) to around 1,9 billion euro (FASTWEB).

The sample companies represent about 67% of total market capitalization of Nuovo Mercato as at 31 December 2003, and 80% of total traded value over the year preceding the event.

Table 3.2 shows that stocks under observation are heterogeneous both in terms of liquidity, and in terms of turnover by value. In fact, TISCALI experienced a mean inside spread of around 17 basis points, whereas CDC POINT's spread reached on average 103 basis points. As far as trading activity is concerned, EL.EN's stocks were the least traded over the sample period with an average daily aggregate traded value of 56 thousands euro. By contrast, TISCALI's stocks were the most traded with a mean total traded value of 24 million euro.

| Summary statistics for the treated sample | | | | | | | |
|---|-----------|-------|---------|--------|--------|---------|--------|
| | Std. Dev. | Min | 1st Qu. | Median | Mean | 3rd Qu. | Max |
| INSIDE SPREAD (in bps) | 25,26 | 17,13 | 38,63 | 60,13 | 60,13 | 81,63 | 103,1 |
| MARKET CAPITALISATION (in mn of euro) | 547,47 | 66,61 | 540,4 | 1.014 | 1.014 | 1.488 | 1.962 |
| AGGREGATE TRADED VALUE (in thousands of euro) | 6.993,30 | 56,06 | 6.112 | 12.170 | 12.170 | 18.220 | 24.280 |

Table 3.2 - The above liquidity and trading activity measures are averaged for every stock across the sample period. By inside spread, I mean the end of day difference between the best bid and ask prices divided by the midpoint. Market capitalization is computed as the stock's end of day price multiplied by the number of ordinary shares in issue. The aggregate traded value is the value of all trades occurred on particular day.

3.5.4 The control sample

By control sample, I mean a group of stocks that didn't experience any change in the intermediary identity disclosure regime over the sample period.

To build such a sample, I followed the procedure used by Friederich and Payne. In particular, I picked control shares from the StoxxEurope 600 index that includes large, medium and small capitalization firms across 18 European countries.

For comparability reasons, I selected only the constituents operating in the same industries as the firms included in the treated sample: technology and telecommunications sectors.

Afterwards, I discarded those stocks that were traded on the Frankfurt Stock Exchange's XETRA and on Mercato Telematico Azionario (i.e. TELECOM ITALIA and STMICROELECTRONICS) because they underwent the introduction of a CCP system in March 2003 and in January 2004, respectively.

The group of stocks I was left with was made up of 12 candidate firms:

Table 3.3 – *The unmatched control stocks*

| CANDIDATE CONTROL SAMPLE |
|-----------------------------|
| TELEFONICA |
| ORANGE |
| KPN KON |
| ELISA |
| ASML HOLDING |
| NOKIA |
| DASSAULT SYSTEMES |
| CAP GEMINI |
| ALCATEL - LUCENT |
| ATOS |
| INGENICO GROUP |
| ASM INTERNATIONAL |

Because of the observational nature of my study (i.e. the treatment that each stock receives is determined beyond the control of the investigator), treatment selection may be influenced by stock's baseline characteristics. Large differences between the treated and control groups in observed baseline characteristics may lead to biased estimates of treatment effects.

A method used to reduce or eliminate the effects of measurable confounding when using observational data is *the propensity score matching*. This technique makes use of the so called propensity score, defined by Rosenbaum and Rubin (1983a) as “*the conditional probability of assignment to a particular treatment ($Z_i=1$) given a vector of observed covariates (X_i)*”:

$$e(x_i)=\text{pr}(Z_i=1 | X_i=x_i)$$

The propensity score has the property to be a balancing score because, conditional on the propensity score, the observable covariates present homogenous distribution within the treated and control groups.

Propensity score matching involves creating matched groups of treated and untreated units presenting similar propensity scores. Thus, it allows to balance the distribution of measured baseline characteristics in the treated and control sample and to replicate a mini-randomized experiment at least with respect to the covariates.

There are several ways of matching treatment cases to control cases based on propensity scores:

- (Greedy) Nearest neighbor, which selects for each treated individual units the control unit with the closest propensity score. When using the nearest neighbor matching, it is also possible to select the number of good matches for each treated units (i.e. every

treated unit is matched with two or more control units sharing the most similar propensity score), especially when the control sample is larger than the treated sample. In this case we talk about ratio matching. Another decision is whether matching should be “with” or “without replacement”, that is, if some control units can or cannot be used as a match for multiple treated units. The matching with replacement is the most effective in reducing selection biases and enhancing the average quality of matching. This option should be allowed for when the distribution of propensity scores between main and control groups diverges: for instance, when there are many treated units with high propensity scores and a large number of controls with low propensity scores.

- Optimal matching, which finds the closest control match for each treated units and at the same time tries to minimize the average absolute distance⁶² across all matched pairs.
- Sub-classification, which divides the data set into sub-groups within which measured covariates have similar distribution conditional on the propensity score;
- Full matching, which is a more advanced type of sub-classification that generates matched sets made up of one treated unit and at least one control. Within each sub-group the weighted average of the estimated distance between each treated unit and each control unit is minimized.
- Weighting, where propensity scores are used directly in the outcome analysis. In particular, they serve as inverse weights in the estimation of the average treatment effect (Inverse Probability of Treatment Weighting).

To derive a matched control sample for the conduct of my study, I availed myself of the package MatchIT offered by the statistical software R⁶³.

When estimating the propensity scores I used the logistic regression, and I considered as covariates the stock’s end of day market capitalization and the daily aggregate traded value averaged across the pre-event period.

For a covariate to be included, the following property needs to be satisfied: correlation with the outcome variable and, eventually, with the treatment assignment. In fact, the absence of

⁶² In the case of propensity score matching, the distance is defined either as $D_{ij} = |e_i - e_j|$ or as $D_{ij} = |\logit(e_i) - \logit(e_j)|$, where e_i is the propensity score of unit i and e_j is the propensity score of unit j .

⁶³ MatchIT is used to perform causal inference when a dichotomous treatment variable (i.e. a variable that takes value 1 if the unit receives treatment and 0 if the units receives control) and a series of pre-treatment observed baseline features are available.

the association with the treatment assignment exerts only a negligible negative effect on the quality of the propensity score estimation.

Since the allocation of the treatment (post-trade anonymity) is not under my control, I am not able to establish whether a relation with the chosen covariates exists, but I can rely on theoretical arguments to assess the existence of some kind of relation with the outcome variable (inside bid-ask spread).

Market capitalization is generally assumed to be inversely related to bid-ask spread, since firm size can be thought to be a proxy of asymmetric information.

Similarly, turnover by value is typically positively correlated with bid-ask spread because liquidity is on average higher on high activity days.

As matching technique, I used the “Nearest Neighbor” method, setting as options:

- “with replacement”: the same control unit can be used as a match for more than one treated unit. Replacement is generally preferred because it allows to obtain a less biased estimate of the treatment effect than “without replacement”;
- “ratio=2”: a treated unit can be matched with up to 2 control units having the closest probability to receive treatment conditional on the pre-treatment covariates. I activated this option because the candidate control sample was a bit larger than the main sample.

Table 3.4 R output showing the effectiveness of the propensity score matching procedure

```
Call:
matchit(formula = T ~ M + V, data = mydata, method = "nearest",
         replace = TRUE, ratio = 2)

Summary of balance for all data:
      Means Treated Means Control  SD Control  Mean Diff  eQQ Med  eQQ Mean  eQQ Max
distance  0.7718      0.2092      0.3116      0.5627      0.8013      0.6077      0.859
M          331.9627    17182.6308    24667.2169  -16850.6681  3409.4500  13856.8045  70956.010
V          2032.7091    102144.4250    125082.8135 -100111.7159  46440.6000  83898.1182  353707.600

Summary of balance for matched data:
      Means Treated Means Control  SD Control  Mean Diff  eQQ Med  eQQ Mean  eQQ Max
distance  0.7718      0.6853      0.2193      0.0865      0.2158      0.2511      0.515
M          331.9627     666.8736      790.6580    -334.9109     863.3800    955.4260    1930.920
V          2032.7091     7193.4591    29669.5114  -5160.7500    2002.1000   24767.3400  115873.400

Percent Balance Improvement:
      Mean Diff.  eQQ Med  eQQ Mean  eQQ Max
distance  84.6271  73.0648  58.6806  40.0467
M          98.0125  74.6769  93.1050  97.2787
V          94.8450  95.6889  70.4793  67.2403

Sample sizes:
      Control Treated
All          12      11
Matched       5      11
Unmatched     7       0
Discarded     0       0
```

Source: author's elaboration

The matching procedure is aimed at generating a dataset that resembles as much as possible the one arising from an experimental study, which holds the desirable property of randomization. Once this similarity is achieved, the treatment variable and the pre-treatment covariates are no more linked. This occurs only if the control variables present close distribution within the matched treated and control sample.

The closeness of covariate distributions is called “balance” and is the basis on which the effectiveness of the matching procedure is assessed.

Table 3.4 reports the summary of the balance for the entire and matched data-set, the percentage balance improvement after matching and the composition of control and treated groups before and after matching.

The balance statistics for the propensity score (distance) and the two covariates (M= market capitalization and V= aggregate traded value) include:

- the weighted mean in the treated and control groups;
- the standard deviation computed in the control sample;
- the difference in mean between treated and control groups;
- the mean, median and maximum distance between the empirical quantile function of the treated groups and the empirical quantile function of the control group.

The results show that the propensity score matching was successful for this dataset.

As shown in the summary of balance for all data, before matching, the stocks experiencing the introduction of post-trade anonymity presented a smaller mean market capitalization by 16 billion euro and a lower mean aggregate traded value by 100 million euro than the control stocks.

After matching, however, the differences in means significantly decreased. As far as market capitalization is concerned, the difference in means reduced by almost 98% (see percentage balance improvement) reaching about 335 million euro. Similarly, the difference in means of the aggregate traded value declined to 5 million: a reduction approaching 95%.

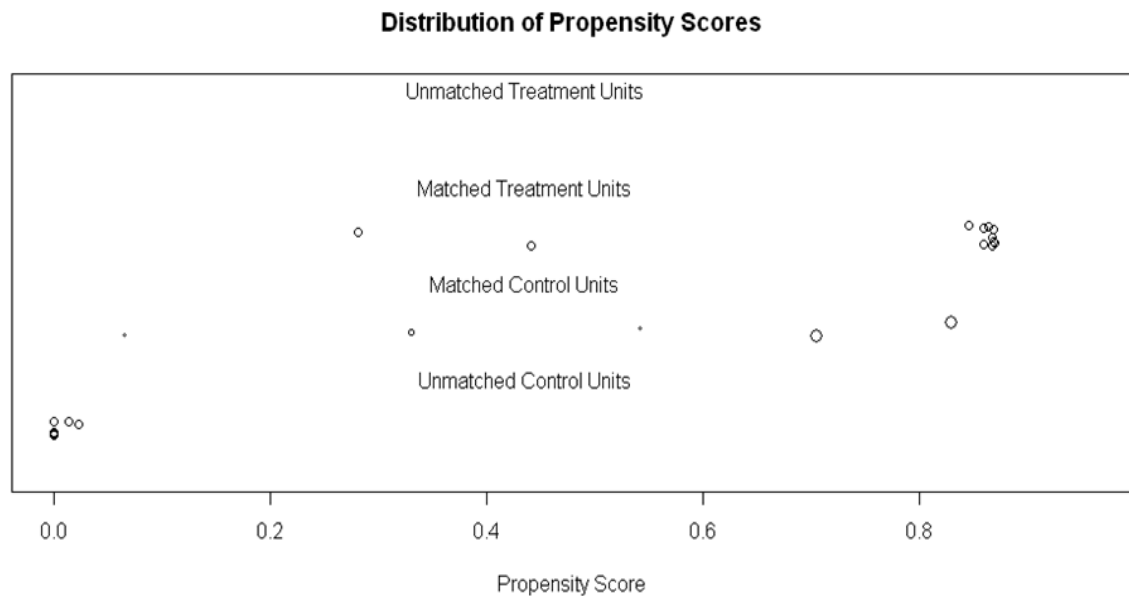
Furthermore, the matching procedure led to the creation of quite homogeneous matched treated and untreated units in terms of propensity score (distance): the difference in means is switched from 56% to 8%.

All Quantile-Quantile (Q-Q) plot differences take smaller values after matching, meaning that the empirical distribution of covariates between the two groups has become more similar.

In the end, **5** out of 12 candidate **control stocks** served as a match, whereas **no treated stock** remained **unmatched**.

The balance can be assessed not only through numerical summaries but also using graphical diagnostics.

Table 3.5 *Distribution of Propensity scores (Jitter Plot)*



Source: author's elaboration

Table 3.5 shows a jitter plot that illustrates the overall distribution of propensity scores in the treated and control sample. Each circle corresponds to a stock's propensity score and its size depends on the weight attributed to that stock. The weight is proportional to the number of treatment units to which it was matched.

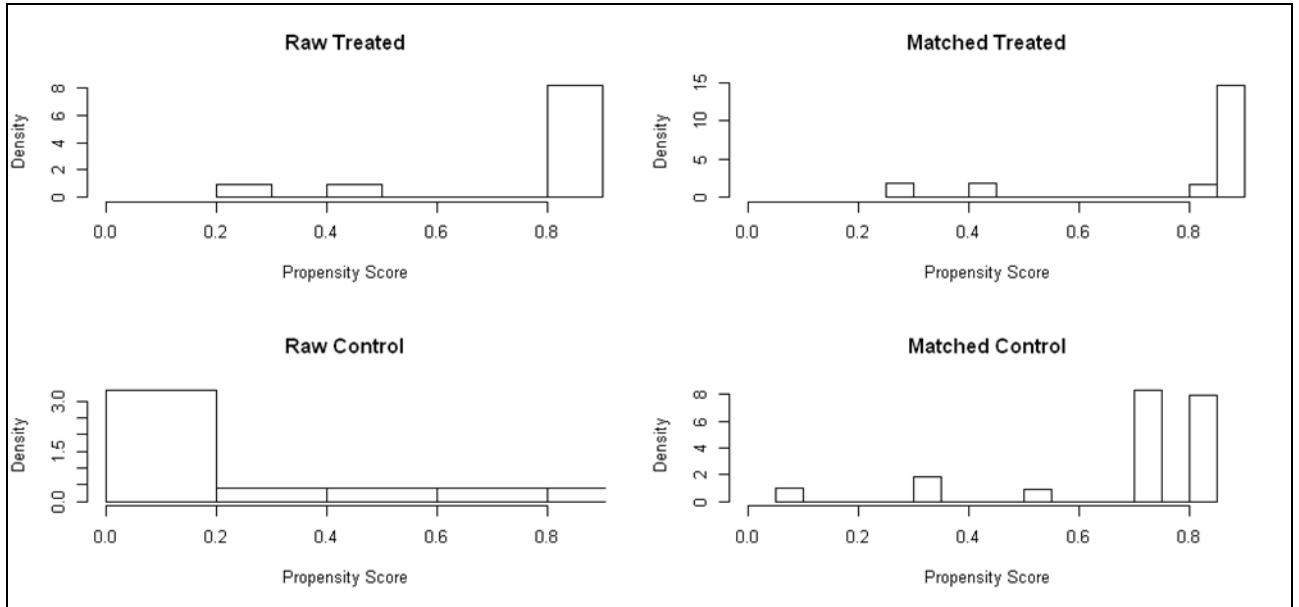
If we look at the chart, we will realize the reason why 7 control units remained unmatched: their conditional probability of being subject to post-trade anonymity approached 0%, compared to an average 77% (see Table 3.4) of matched treated units.

In other words, the main sample stocks mainly lie on the right side of the graph, whereas the unmatched untreated items principally cover the lefts side.

As you can see, the two matched control stocks with the highest propensity score (i.e. **INGENICO GROUP** and **ASM INTERNATIONAL**) were given a greater weight (the size of the circle is wider), meaning that they were used as a match for more than one-treated stocks. This is because their likelihood to be assigned to treatment was comparable to the majority of treated stocks. Conversely, the remaining stocks received a smaller weight, since their propensity scores were similar to only a few units of the main sample.

Another graphical check of whether observed systematic differences between the two groups have been removed consists in plotting the histogram of the distribution of the propensity scores pre- and post-matching.

Table 3.6 *Density Distribution of Propensity scores (Histogram Plot)*

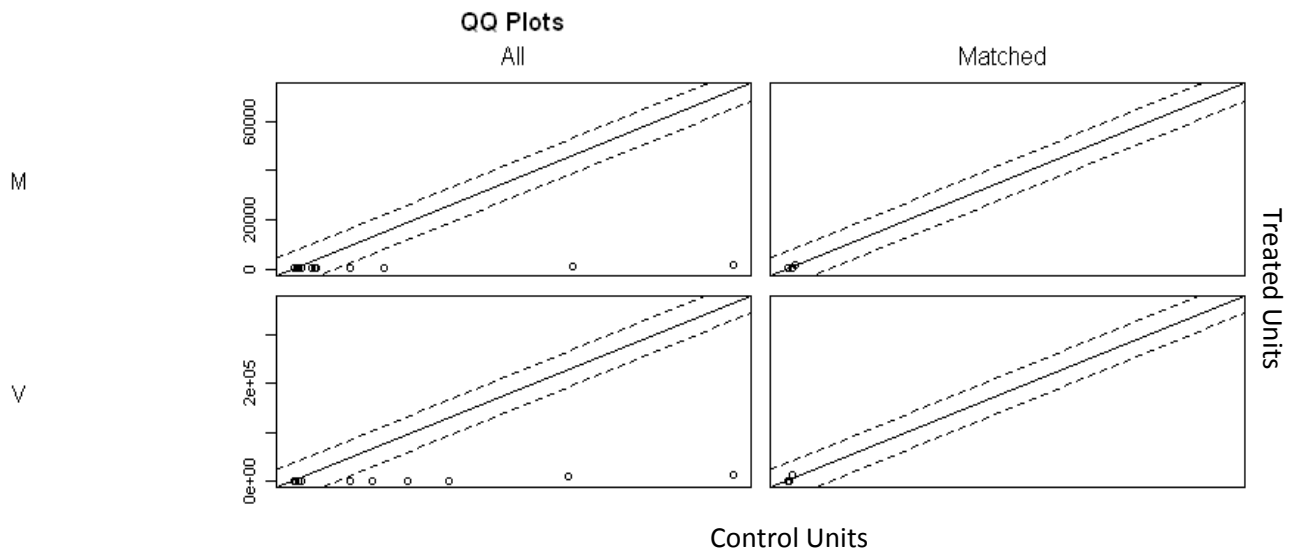


Source: author's elaboration

To gauge the overall balance improvement, we need to first compare the distribution of the estimated propensity scores in the original main group versus the original comparison group (left side of the chart). Then, we need to compare the distribution in the matched treated units versus the matched control units (right side of the chart).

In the pre-matching stage the density histograms look opposite, signaling a poor covariate balance: the Nuovo Mercato stocks present a distribution skewed to the right, whereas StoxxEurope 600 constituents present a distribution skewed to the left.

In the post-matching stage this situation has improved. The right hand side plots, which are created using the weight resulting after matching, show almost even distributions.

Table 3.7 Empirical Quantile-Quantile plots of each covariate (market capitalization and aggregate traded value)

Source: author's elaboration

Table 3.7 reports four QQ plots, two for each covariate: one built using the entire data set and one using only the matched items.

The Empirical Quantile-Quantile plots show the covariate values that fall roughly in the same quantile of the treated and control distributions. The Nuovo Mercato stocks' quantile values are reported on the vertical axis, whereas the StoxxEurope 600 constituents' quantile values on the horizontal axis⁶⁴.

In this case, before matching, both market capitalization and turnover by value present different distributions in the treated and control groups. More specifically, the majority of points lie below the “ideal” diagonal, signaling that treated units generally take lower value of covariates than control units.

After matching, covariates present approximately the same quantiles in both groups. Again, the comparison of the charts on the left side with the charts on the right side shows a remarkable balance improvement.

Another evidence of the effectiveness of the matching procedure is provided by the plot (table 3.8) of the absolute standardized difference in means⁶⁵ of each covariate for all the data and matched data.

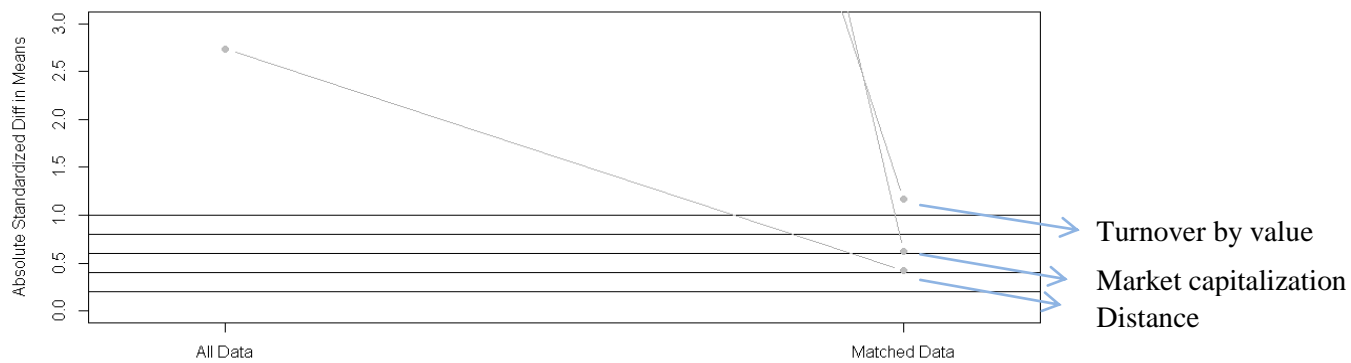
Each point in the graph represents either one of the two covariates or the distance (propensity score). The improvement stands out. In fact, although the scale of the chart doesn't allow to

⁶⁴ If all the points lie on the 45 degrees line, the empirical distributions of the two groups are equal. By contrast, if the points lie far from the diagonal, deviations exist.

⁶⁵ The standardization is obtained by dividing the difference in means for the standard deviation in the treated group.

see where the absolute standardized difference in means of the two covariates for the entire dataset stands, the line linking the points pre-matching and post-matching is very steep. For the numerical summary of the standardized difference in means see table 3.9.

Table 3.8 Plot of the standardized difference in means of the covariates and the distance



Source: author’s elaboration

Table 3.9 Summary of the standardized difference in means of the covariates and the distance

| Summary of balance for all data: | | | | | | | |
|--------------------------------------|-----------------|---------------|-------------|-----------------|----------|--|--|
| | Means Treated | Means Control | SD Control | Std. Mean Diff. | eCDF Med | | |
| distance | 0.7718 | 0.2092 | 0.3116 | 2.7299 | 0.5455 | | |
| M | 331.9627 | 17182.6308 | 24667.2169 | -31.3204 | 0.5000 | | |
| V | 2032.7091 | 102144.4250 | 125082.8135 | -22.6592 | 0.4545 | | |
| | eCDF Mean | eCDF Max | | | | | |
| distance | 0.4776 | 0.8182 | | | | | |
| M | 0.4470 | 0.8182 | | | | | |
| V | 0.4167 | 0.7348 | | | | | |
| Summary of balance for matched data: | | | | | | | |
| | Means Treated | Means Control | SD Control | Std. Mean Diff. | eCDF Med | | |
| distance | 0.7718 | 0.6853 | 0.2193 | 0.4197 | 0.3364 | | |
| M | 331.9627 | 666.8736 | 790.6580 | -0.6225 | 0.3364 | | |
| V | 2032.7091 | 7193.4591 | 29669.5114 | -1.1681 | 0.3182 | | |
| | eCDF Mean | eCDF Max | | | | | |
| distance | 0.3727 | 0.8182 | | | | | |
| M | 0.3727 | 0.8182 | | | | | |
| V | 0.3364 | 0.7273 | | | | | |
| Percent Balance Improvement: | | | | | | | |
| | Std. Mean Diff. | eCDF Med | eCDF Mean | eCDF Max | | | |
| distance | 84.6271 | 38.3333 | 21.9637 | 0.0000 | | | |
| M | 98.0125 | 32.7273 | 16.6102 | 0.0000 | | | |
| V | 94.8450 | 30.0000 | 19.2727 | 1.0309 | | | |

Source: author’s elaboration

In sum, all balance diagnostics both graphical and numerical provide evidence of the fact that the applied procedure has led to the selection of well-matched samples of the original treated and control groups, thereby decreasing biases due to covariates.

In the end, all Nuovo Mercato stocks have found a match, whereas only 5 out of 12 StoxxEurope 600 constituents will be used for follow-up analysis:

Table 3.10

| MATCHED CONTROL SAMPLE |
|---------------------------|
| ELISA |
| CAP GEMINI |
| ATOS |
| INGENICO GROUP |
| ASM INTERNATIONAL |

As table 3.11 shows, the firms included in the final comparison group operate in technology and telecommunications industries and their average market values (computed over the sample period) range from around 301 million euro (INGENICO GROUP) to around 3,7 billion euro (CAP GEMINI). The stocks are heterogeneous both in terms of liquidity and turnover by value. In fact, CAP GEMINI experienced a mean inside spread of around 11 basis points, whereas ELISA's spread reached on average 67 basis points. As far as trading activity is concerned, INGENICO's stocks were the least traded over the sample period with an average daily aggregate traded value of 1,3 million euro. By contrast, CAP GEMINI's stocks were the most traded with a mean total traded value of 45,7 million euro.

| Summary statistics for the control sample | | | | | | | |
|---|-----------|-------|---------|--------|--------|---------|--------|
| | Std. Dev. | Min | 1st Qu. | Median | Mean | 3rd Qu. | Max |
| INSIDE SPREAD (in bps) | 16,60 | 11,20 | 25,20 | 39,20 | 39,20 | 53,20 | 67,20 |
| MARKET CAPITALISATION (in mn of euro) | 960,85 | 301,1 | 1.133 | 1.965 | 1.965 | 2.796 | 3.628 |
| AGGREGATE TRADED VALUE (in thousands of euro) | 12.798,85 | 1.384 | 12.470 | 23.550 | 23.550 | 34.640 | 45.720 |

Table 3.11 - The above liquidity and trading activity measures are averaged for every stock across the sample period. By inside spread, I mean the end of day difference between the best bid and ask prices divided by the midpoint. Market capitalization is computed as the stock's end of day price multiplied by the number of ordinary shares in issue. The aggregate traded value is the value of all trades occurred on particular day.

3.6 The model specification.

My study relies on the empirical research conducted by Friederich and Payne (2011) who analyzed the equity trading platform SETS of LSE around the introduction of post-trade anonymity in 2001.

The objective of their study was to assess the impact that this event had on market quality and in particular on liquidity. In order to perform such evaluation, they built a treated sample of 132 SETS stocks and a control sample of 155 StoxxEurope 600 stocks. The observation period included 6 months before and after the CCP implementation.

Friederich and Payne used as unit of analysis the following liquidity measures: daily time weighted inside bid-ask spread, daily time weighted bid-ask spread at the fifth limit price and average daily depth available at those spreads.

Unfortunately, Thomson Reuters Datastream Database provided only data concerning spreads at the best quotes and so I had to limit my analysis to this measure of liquidity.

I applied the same model employed in Friederich and Payne's research, a panel model with difference-in-difference specification, with some adjustments due to unavailability of some data (eq. 1):

$$S_{i,t} = \alpha_i + \beta_1 V_{i,t} + \beta_2 RVOL_{i,t} + \beta_3 \text{LogMKTCAP}_{i,t} + \gamma_1 D_i^{\text{Treat}} + \gamma_2 D_t^{\text{Anon}} + \Delta D_{i,t}^{\text{Treat} \times \text{Anon}} + \epsilon_{i,t} \quad (1)$$

The dependent variable, $S_{i,t}$, is the daily closing bid-ask spread for stock i on day t expressed in basis points. This spread is computed as the difference between the best bid and ask prices quoted at the close of the market each day, divided by the mid-quote.

In this case the databases didn't allow me to compute a daily time weighted average like Friederich and Payne. However, it is not unusual to use daily closing prices instead of intraday prices: for example, this approach was followed by Acker *et al.* (2002) when investigating the behavior of inside spreads around corporate earning announcements in London Stock Exchange.

As far as the explanatory variables are concerned:

- $V_{i,t}$ is the value of all trades for stock i on day t expressed in money terms. The aggregate traded value was rescaled by the number of shares of stock i traded on day t in order to increase comparability across securities. I extracted the turnover by value and turnover by volume from Datastream datatypes⁶⁶ VA and VO, respectively. The more actively a stock is traded, the stronger is the competition among traders, improving bid and ask prices. As a consequence transaction costs, measured by bid-ask spread, decline. Thus, the coefficient β_1 , which represents the correlation between spread and aggregate traded value, is expected to be negative.
- $RVOL_{i,t}$ is the realized volatility of stock i on day t . In measuring stocks' daily realized volatility I followed the approach used by Comerton-Forde *et al.* (2005):

⁶⁶ Datastream datatypes are acronyms identifying specific financial/accounting data.

$$RVOL_{i,t} = \ln \left(\frac{High_{it}}{Low_{it}} \right)$$

where High is the highest price of stock i achieved on day t (Datastream datatype PH) and Low is the lowest price of stock i achieved on day t (Datastream datatype PL).

When stock volatility is high, rapid price changes are more likely to occur within the short run. Traders, in particular day traders who prefer to lay off their inventory by the end of the trading day, may heavily lose to informed trades when trading at narrow bid-ask spread. This is due to the fact that privately informed traders trade aggressively in the short run because of high price volatility.

Day traders, therefore, protect themselves against such adverse selection risk by quoting wider bid-ask spreads when market volatility is high. Thus the coefficient β_2 , which represents the correlation between bid-ask spread and stock level volatility, is expected to be positive;

- **LogMKTCAP_{*i,t*}** is the logarithm of market capitalization of stock i at the end of day t . The information about market capitalization was extracted from Datastream datatype MV, which returns the result of the multiplication between the price of each shares and the number of ordinary shares in issue on a particular day. Since market capitalization can be viewed as a proxy of firm size, we would expect it to be negatively correlated with bid-ask spread ($\beta_3 < 0$.) In fact, large firms generally publish more information than small firms, and they are closely followed by the investment community. Consequently, prices of stocks of high market cap firms incorporate more information and, thus, the problem of information asymmetry is less severe for such firms.
- **D_{*i*}^{Treat}** is a dummy variable taking value 1 if stock i belongs to the treated sample and 0 if stock i belongs to the control sample. The coefficient γ_1 captures spread differences between treated and control group prior to CCP introduction.
- **D_{*t*}^{Anon}** is a dummy variable taking value 1 if the observation is in the post-CCP period and 0 if it is in the pre-CCP period. The coefficient γ_2 captures changes in spread over time in the control group;

- $D_{i,t}^{\text{Treat} \times \text{Anon}}$ is an interaction term between the dummy variable isolating the treated sample stocks and the dummy variable indicating the post-CCP period. This interaction term is the variable of interest, since its coefficient (Δ) is the difference in difference estimate of the treatment effect on the treated sample:

$$\Delta = (E[S_{i,t} | D_i^{\text{Treat}} = 1, D_t^{\text{Anon}} = 1] - E[S_{i,t} | D_i^{\text{Treat}} = 1, D_t^{\text{Anon}} = 0]) - (E[S_{i,t} | D_i^{\text{Treat}} = 0, D_t^{\text{Anon}} = 1] - E[S_{i,t} | D_i^{\text{Treat}} = 0, D_t^{\text{Anon}} = 0]) \quad (2)$$

It follows that the population average difference over time in the control sample is subtracted from the population average difference over time in the treated sample.

Thus, the difference-in-difference methodology allows to eliminate biases arising from:

- permanent intergroup differences, when comparing treatment and control sample in the post-CCP period and
- time trends, not attributable to the treatment when comparing the treated group over time.

$\epsilon_{i,t}$ is the idiosyncratic error which varies across individuals and over time.

The fundamental assumption underlying OLS is the absence of correlation between the error term, incorporating any feature of the individuals not explicitly controlled for in the model, and the independent variables. This property is called exogeneity.

If such correlation exists, we cannot rely on OLS estimates to make causal inference.

I, therefore, dealt with endogeneity by using instrumental variables. In order to be used as instrument, a variable must be uncorrelated with the error but correlated with the endogenous X. In other words, it must affect only indirectly (by means of X) the outcome variable.

Like Friederich and Payne, I used as instrumental variables the regressors lagged by two periods, e.g. the aggregate traded value lagged by two days.

Another issue concerns OLS standard errors. To rely on OLS standard errors, the residuals have to be independent and identically distributed. When running a regression on panel data, we should take into account the fact that residuals might be correlated across individuals and over time, leading to biased standard errors. In such a situation the variability and, consequently, the significance of coefficient estimates would be over or underestimated.

Therefore, for all the panel regressions that I run, I tested for serial correlation, for cross-sectional dependence in the idiosyncratic error and for heteroskedasticity.

To assess the presence of serial correlation in the idiosyncratic error⁶⁷, I performed the Breusch-Godfrey/Wooldridge test. This test relies on the alternative that the error follows a first-order autoregressive process (AR(1)):

$$\epsilon_{i,t} = \rho_1 \epsilon_{i,t-1} + e_{i,t}$$

$$\text{where } E(e_{i,t} | X_{i,t}, \epsilon_{i,t-1}, X_{i,t-1}, \epsilon_{i,t-2} \dots) = 0$$

Under the null hypothesis of no serial correlation, $\rho_1 = 0$.

For every panel regression, the p-value was lower than 0.05 and, therefore, I rejected the null hypothesis:

Breusch-Godfrey/Wooldridge test for serial correlation in panel models⁶⁸

data: $Y \sim X$

chisq = 510.45, df = 409, p-value = 0.0004616

alternative hypothesis: serial correlation in idiosyncratic errors

Then, I performed the Breusch-Pagan Lagrange Multiplier test for cross-sectional dependence to test the null hypothesis of zero error correlation across entities (in this case stocks):

$$H_0: \text{Cov}(\epsilon_{i,t}, \epsilon_{j,t}) = 0, \text{ for all } t \text{ and } i \neq j$$

In this case, for all panel regressions, I failed to reject the null hypothesis since the p-value was larger than 0.05.

Breusch-Pagan LM test for cross-sectional dependence in panels⁶⁹

data: formula

chisq = 142.14, df = 120, p-value = 0.08196

alternative hypothesis: cross-sectional dependence

⁶⁷ i.e. correlation between error terms from different time periods because of a time constant omitted factor.

^{68, 69, 70} These are the results of the test performed for the first regression that I run. From the qualitative point of view, they are similar to the results obtained for the cross-sectional regressions.

Finally, I checked for heteroskedasticity, i.e. non constant error variance, through Breusch Pagan test which tests the null hypothesis of homoscedasticity:

$$\text{Var}(\epsilon_{i,t}) = \sigma^2 h(\mathbf{X}'_{i,t} \delta)$$

Where $\mathbf{X}_{i,t}$ is the K -dimensional vector of explanatory variables and for the function $h(\cdot)$, $h(0) = 1$ and $h(\cdot) > 0$ holds.

The null hypothesis is $\delta=0$ and, thus, $\text{Var}(\epsilon_{i,t}) = \sigma^2$.

For all the panel regressions, I rejected the null hypothesis of homogeneity given a p-value lower than 0.05.

Breusch-Pagan test⁷⁰

data: $Y \sim X$

BP = 115.91, df = 6, p-value < 2.2e-16

To deal with heteroskedasticity and serial correlation in the idiosyncratic error which lead to biased standard errors of coefficient estimates, I used robust matrix covariance estimators when running the panel regressions. The robust matrix covariance estimators allow to reduce biases in the estimate of the standard errors due to stock and time-specific clustering.

3.7 The Results

In this section I discuss the results of the model estimation both at the market level and at a cross-sectional level. Before analyzing the empirical findings, I would like to briefly recall two theoretical views explaining the potential effects of anonymity on liquidity.

The first is the asymmetric information theory, which yields conflicting results.

On one hand, under exogenous information acquisition, liquidity is negatively affected by post-trade anonymity, as it emphasizes the adverse selection problem (Huddart *et al.*, 2001).

On the other, under endogenous information procurement, liquidity and informational efficiency are boosted by counterparty identity concealment, since traders are encouraged to collect new information (Rindi, 2008)

The second theory, instead, relies on order anticipation arguments which forecast an improvement in liquidity because large traders are less likely to be anticipated and, therefore, engage in more patient execution.

3.7.1 Post-trade anonymity and liquidity: overall market implications.

Table 3.12 reports the results of OLS estimation of the difference-in difference panel model.

The regression output shows that two of the control variables accounting for time-varying stock specific conditions (i.e. the daily stock-level realized volatility and the daily stock aggregate traded value) are insignificant in explaining differences among stocks in the expected value of the daily closing inside spread.

The estimated coefficient of stock daily market capitalization is negative and highly statistically significant: a one per cent increase in market capitalization (*ceteris paribus*) is expected to produce a decrease, although tiny, in inside bid-ask spread of about 0.002 basis points. This is consistent with the fact that the extent of information asymmetries is generally smaller for large firms.

The estimated coefficient of the dummy variable isolating the treated sample indicates that when switching from the control group to the treated group in the pre-CCP period, an increase in daily closing inside spreads by 35 basis points is expected. The picture that emerges is in line with tables 3.2 and 3.11, whose comparison has highlighted a wider spread, on average, in Nuovo Mercato stocks.

The estimated coefficient of the anonymity indicator shows that when we switch to the post-CCP period, *ceteris paribus*, an increase of inside spreads of around 30.6 basis points is expected. This would signal that spreads in control stocks widened under anonymity.

As far as the interaction term (our critical variable) is considered, we cannot conclude anything about the average treatment effect on the treated sample as the estimated coefficient is not statically significant.

The impossibility to reach conclusions about the implementation of a CCP system at “macro-level” suggested me to conduct two cross-sectional analyses: small cap versus large cap stocks and low depth versus high depth stocks.

Table 3.12 Output of the difference-in-difference model estimation “at macro-level”

| | | | | |
|---|------------|------------|---------|---------------|
| Unbalanced Panel: n=16, T=409-424, N=6691 | | | | |
| Residuals : | | | | |
| Min. | 1st Qu. | Median | 3rd Qu. | Max. |
| -2710.0 | -1080.0 | 16.4 | 1100.0 | 2710.0 |
| Coefficients : | | | | |
| | Estimate | Std. Error | t-value | Pr(> t) |
| (Intercept) | 40.2108702 | 2.892368 | 13.9024 | < 2.2e-16 *** |
| V | -0.016561 | 0.028704 | -0.5770 | 0.5639943 |
| RVOL | -0.115674 | 0.125264 | -0.9234 | 0.3558325 |
| LogMKTCAP | -0.205362 | 0.053148 | -3.8640 | 0.0001133 *** |
| TR | 35.018580 | 15.518293 | 2.2566 | 0.0240895 * |
| AN | 30.579796 | 6.987431 | 4.3764 | 1.237e-05 *** |
| TR*AN | 12.868082 | 125.221506 | 0.1028 | 0.9181566 |
| --- | | | | |
| Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 | | | | |
| Total Sum of Squares: 1.1963e+10 | | | | |
| Residual Sum of Squares: 1.1527e+10 | | | | |
| R-Squared: 0.36456 | | | | |
| Adj. R-Squared: 0.36417 | | | | |
| F-statistic: 42.148 on 6 and 6684 DF, p-value: < 2.22e-16 | | | | |

Source: author's elaboration

3.7.2 Post-trade anonymity and liquidity: cross-sectional implications.

3.7.2.a Small vs. large stocks

I divided the treated and the control samples in 3 subgroups on the basis of the stock's average daily market capitalization in the pre-event period. Then, I ran separate regressions for each subsample.

Table 3.13 shows the results of the difference-in-difference model estimation using the Nuovo Mercato Stocks (ESPRINET, REPLY, DADA, EL.EN.) and StoxxEurope 600 constituents (INGENICO GROUP and ASM INTERNATIONAL) falling in the first size tercile i.e. low-cap securities.

Two of the control variables accounting for time-varying stock specific conditions, i.e. aggregate traded value and market capitalization, present a statistically significant (at 0.01 level and at 0.05 significance level respectively) and negative estimated coefficients. The sign of the coefficients is in line:

- with the fact that the higher the trading activity, the stronger competition among traders and the narrower bid-ask spread and
- with firm size proxying asymmetric information.

The estimated coefficient of the dummy variable identifying Nuovo Mercato stocks shows that when switching from the control to the treated first tercile subsample in the pre-CCP period, an increase in inside spreads by 52.6 basis points is expected. This conforms to my expectations.

The anonymity indicator highlights, *ceteris paribus*, an expected increase in the inside spreads of about 83 basis points, when switching to the post-trade anonymous regime. This would imply that liquidity of small cap control stocks has fallen after the CCP implementation.

Finally, the estimated coefficient of the variable of interest suggests that the regulatory intervention has had a significant impact on the liquidity of small cap Nuovo Mercato stocks. In particular, the average treatment effect on the treated sample is a decrease in inside spreads of about 14 basis points.

Table 3.13 Results of the difference-in-difference model estimation for the first size tercile.

| | | | | |
|---|------------|------------|---------|---------------|
| Unbalanced Panel: n=6, T=416-424, N=2514 | | | | |
| Residuals : | | | | |
| Min. | 1st Qu. | Median | 3rd Qu. | Max. |
| -1120.0 | -489.0 | 22.1 | 502.0 | 1090.0 |
| Coefficients : | | | | |
| | Estimate | Std. Error | t-value | Pr(> t) |
| (Intercept) | 82.453678 | 6.00020 | 13.7418 | < 2.2e-16 *** |
| V | -0.051483 | 0.020094 | -2.5622 | 0.0104501 * |
| RVOL | 0.0090291 | 0.113806 | 0.0793 | 0.9367670 |
| LogMKTCAP | -0.29156 | 0.172072 | -1.6944 | 0.0934223. |
| TR | 52.64201 | 20.707265 | 2.5422 | 0.0103502* |
| AN | 83.387654 | 21.486679 | 3.8809 | 0.0001063 *** |
| TR*AN | -14.170235 | 6.5175011 | -2.1741 | 0.0240896 * |
| --- | | | | |
| Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 | | | | |
| Total Sum of Squares: 868690000 | | | | |
| Residual Sum of Squares: 859600000 | | | | |
| R-Squared: 0.104750 | | | | |
| Adj. R-Squared: 0.104450 | | | | |
| F-statistic: 4.42297 on 6 and 2507 DF, p-value: 0.00018595 | | | | |

Source: author's elaboration

Table 3.14 reports the results of the regression using equities from the second size tercile of the treated sample and the second size tercile of the comparison group. The Nuovo Mercato stocks included in the second subsample by market capitalization are MONDO TV, CDC POINT and CAD IT, whereas only ELISA among StoxxEurope 600 constituents.

In this case only market capitalization shows a (borderline) statically significant coefficient and its sign is consistent with intuition: a one percent increase in the variable, ceteris paribus, is associated with an expected decrease, even if tiny, in inside spreads of about 0.004 basis

points. Again, the findings show that, prior to the introduction of post-trade anonymity, medium cap treated stocks have wider inside spreads than medium cap control stocks: the average differential is about 56 basis points.

Even in this case, a reduction in liquidity of control stocks under anonymity is highlighted.

The interaction term suggests a significant decrease in inside spreads of medium cap Nuovo Mercato stocks as a result of the CCP introduction. Further, the average extent of liquidity improvement is larger than small cap treated stocks both in basis points (30 bps vs. 14 bps) and as a percentage of the average pre-CCP inside spread⁷⁰ (28.87% vs. 10.49%).

Table 3.14 Results of the difference-in-difference model estimation for the second size tercile

| | | | | |
|---|------------|------------|---------|---------------|
| Unbalanced Panel: n=4, T=414-419, N=1670 | | | | |
| Residuals : | | | | |
| Min. | 1st Qu. | Median | 3rd Qu. | Max. |
| -853 | -369.00 | 4.5 | 362.00 | 808.00 |
| Coefficients : | | | | |
| | Estimate | Std. Error | t-value | Pr(> t) |
| (Intercept) | 47.743040 | 6.149363 | 7.7639 | 4.766e-14 *** |
| V | 0.202471 | 0.352546 | 0.5743 | 0.5660173 |
| RVOL | 0.039577 | 0.043856 | 0.9024 | 0.3672641 |
| LogMKTCAP | -0.473249 | 0.280753 | -1.6856 | 0.0924954 . |
| TR | 56.406861 | 26.551902 | 2.1244 | 0.0341281 * |
| AN | 81.222132 | 24.430603 | 3.3246 | 0.0009511 *** |
| TR*AN | -30.070194 | 11.731047 | -2.5633 | 0.0104590 * |
| --- | | | | |
| Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 | | | | |
| Total Sum of Squares: 2987900000 | | | | |
| Residual Sum of Squares: 294220000 | | | | |
| R-Squared: 0.15281 | | | | |
| Adj. R-Squared: 0.15217 | | | | |
| F-statistic: 4.30103 on 6 and 1663 DF, p-value: 0.00025992 | | | | |

Source: author's elaboration

⁷⁰ The average pre-CCP inside spread for the treated sample is given by the sum of the estimated intercept and the coefficient of the dummy variable isolating Nuovo Mercato stocks.

Finally, the regression outputs for high cap treated (FASTWEB, TISCALI, CAIRO COMMUNICATION and DATALOGIC) and control stocks (CAP GEMINI and ATOS) are reported in Table 3.15.

This time around, the average treatment effect on Nuovo Mercato stocks is about 38 basis points, corresponding to 51.45% of the average pre-CCP inside spread. The extent of liquidity improvement is by far larger than medium and small cap treated stocks (28.87% and 10.49% of average pre-CCP spread, respectively).

Table 3.15 Results of the difference-in-difference model estimation for the third size tercile

| | | | | |
|---|------------|------------|---------|---------------|
| Unbalanced Panel: n=6, T=409-422, N=2507 | | | | |
| Residuals : | | | | |
| Min. | 1st Qu. | Median | 3rd Qu. | Max. |
| -1090.000 | -455.000 | 3.54 | 410.0 | 1210.0 |
| Coefficients : | | | | |
| | Estimate | Std. Error | t-value | Pr(> t) |
| (Intercept) | 27.694913 | 2.238479 | 12.3722 | < 2.2e-16 *** |
| V | -0.335061 | 0.337966 | -0.9914 | 0.3220 |
| RVOL | -0.074809 | 0.058351 | -1.2821 | 0.2004 |
| LogMKTCAP | -0.311525 | 0.121112 | -2.5722 | 0.0104602* |
| TR | 47.538780 | 6.897975 | 6.8917 | 1.728e-11 *** |
| AN | 61.216822 | 12.668179 | 4.8323 | 1.816e-06 *** |
| TR*AN | -38.707537 | 5.029304 | -7.6964 | 7.955e-14 *** |
| --- | | | | |
| Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 | | | | |
| Total Sum of Squares: 5811000 | | | | |
| Residual Sum of Squares: 4750400 | | | | |
| R-Squared: 0.18251 | | | | |
| Adj. R-Squared: 0.1799 | | | | |
| F-statistic: 33.1701 on 6 and 2500 DF, p-value: < 2.22e-16 | | | | |

Source: author's elaboration

The cross-sectional analysis based on pre-event market capitalization suggests a global tightening of inside spreads following the introduction of post-trade anonymity.

Such a result leads me to exclude Huddart (2001)'s asymmetric information argument that forecasts, under exogenous information acquisition, a deterioration of liquidity due to the strengthening of information asymmetries in the anonymous regime.

The fact that large cap stocks appear to have benefited the most from broker identity concealment provides evidence in favor of the asymmetric information argument used by Rindi (2008). Stocks endowed with private information should experience a greater reduction in inside spreads under anonymity than stocks endowed with exogenously acquired information (typically small stocks).

The order anticipation theory, instead, predicts the opposite: in the anonymous regime, repeated traders in small stocks should enjoy a larger liquidity increase than dynamic traders in large stocks. This is because the low trading activity that generally characterizes equities with small market capitalization allows anticipators to easily identify traders frequently acting on the same side of the market.

3.7.2.b. Low vs. high depth stocks.

I divided treated and control samples in 3 subgroups on the basis of the pre-event average value of stocks available at the inside spread. Then, I ran separate regressions for each subsample.

Table 3.16 shows the results of the difference-in-difference model estimation using the Nuovo Mercato Stocks (ESPRINET, REPLY, DADA and EL.EN.) and StoxxEurope 600 constituents (INGENICO GROUP and ASM INTERNATIONAL) falling in the first tercile i.e. low-depth securities. Since the treated and control subsamples by depth have the same composition of the subsamples by market capitalization, it is not worth discussing again the regression outputs.

No one of the remaining stocks fall into the second depth tercile. The overall sample, therefore, contains no medium-depth shares.

The regression outcomes for high depth treated (MONDO TV, CDC POINT, CAD IT, FASTWEB, TISCALI, CAIRO COMMUNICATION and DATALOGIC) and control stocks (ELISA, CAP GEMINI and ATOS) are reported in Table 3.17.

Two of the control variables accounting for time-varying stock specific conditions, i.e. aggregate traded value and market capitalization, present highly statistically significant and negative estimated coefficients. The sign of the coefficients is in line with intuition.

The estimated coefficient isolating treated sample stocks shows that when switching from the control to the treated third tercile subsample in the pre-CCP period, an increase in inside spreads by 43.9 basis points is expected.

Furthermore, the results show a widening of inside spreads (68 bps) in the anonymity period for high-depth control stocks.

The analysis of the critical variable highlights an average treatment effect on Nuovo Mercato stocks of about 36 basis points, corresponding to 46.06% of the pre-event average inside spread.

Table 3.16 Results of the difference-in-difference model estimation for the first depth tercile

| | | | | |
|---|------------|------------|---------|---------------|
| Unbalanced Panel: n=6, T=416-424, N=2514 | | | | |
| Residuals : | | | | |
| Min. | 1st Qu. | Median | 3rd Qu. | Max. |
| -1120.0 | -489.0 | 22.1 | 502.0 | 1090.0 |
| Coefficients : | | | | |
| | Estimate | Std. Error | t-value | Pr(> t) |
| (Intercept) | 82.453678 | 6.00020 | 13.7418 | < 2.2e-16 *** |
| V | -0.051483 | 0.020094 | -2.5622 | 0.0104501 * |
| RVOL | 0.0090291 | 0.113806 | 0.0793 | 0.9367670 |
| LogMKTCAP | -0.29156 | 0.172072 | -1.6944 | 0.0934223. |
| TR | 52.64201 | 20.707265 | 2.5422 | 0.0103502* |
| AN | 83.387654 | 21.486679 | 3.8809 | 0.0001063 *** |
| TR*AN | -14.170235 | 6.5175011 | -2.1741 | 0.0240896 * |
| --- | | | | |
| Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 | | | | |
| Total Sum of Squares: 868690000 | | | | |
| Residual Sum of Squares: 859600000 | | | | |
| R-Squared: 0.104750 | | | | |
| Adj. R-Squared: 0.104450 | | | | |
| F-statistic: 4.42297 on 6 and 2507 DF, p-value: 0.00018595 | | | | |

Source: author's elaboration

Table 3.17 Results of the difference-in-difference model estimation for the third depth tercile

| | | | | |
|---|------------|------------|---------|---------------|
| Unbalanced Panel: n=10, T=409-422, N=4184 | | | | |
| Residuals : | | | | |
| Min. | 1st Qu. | Median | 3rd Qu. | Max. |
| -506.0 | -207.0 | 2.12 | 175.0 | 504.0 |
| Coefficients : | | | | |
| | Estimate | Std. Error | t-value | Pr(> t) |
| (Intercept) | 35.369961 | 2.512999 | 14.0748 | < 2.2e-16 *** |
| V | -0.123185 | 0.035877 | -3.4335 | 0.0006206 *** |
| RVOL | -0.083755 | 0.066461 | -1.2602 | 0.2078954 |
| LogMKTCAP | -0.328377 | 0.050786 | -6.4659 | 1.582e-10 *** |
| TR | 43.959008 | 7.753048 | 5.6699 | 1.876e-08 *** |
| AN | 68.002327 | 17.707555 | 3.8403 | 0.0001307 *** |
| TR*AN | -36.535752 | 9.687583 | -3.7714 | 0.0001720 *** |
| --- | | | | |
| Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 | | | | |
| Total Sum of Squares: 61541000 | | | | |
| Residual Sum of Squares: 56862000 | | | | |
| R-Squared: 0.7603 | | | | |
| Adj. R-Squared: 0.75494 | | | | |
| F-statistic: 33.710 on 6 and 2500 DF, p-value: < 2.22e-16 | | | | |

Source: author's elaboration

The cross-sectional analysis based on pre-event depth suggests that all stocks experienced liquidity improvements, especially high depth securities.

This is inconsistent with the order anticipation thesis: low depth stocks should take the greatest advantage from anonymity, since it reduces the chances to be front-run. In fact, the success of anticipation tactics relies on the exploitation of significant price variations that are unlikely to be created when the order book is adequately deep.

3.8 Concluding remarks.

In this chapter I tried to answer the following research question: *how did the introduction of a Central Counterparty system in 2004 affect liquidity of Nuovo Mercato?*

Due to the limited availability of data, I was compelled to restrict my analysis to a single measure of liquidity: inside bid-ask spread. The regression results suggest a *widespread narrowing of spreads* following the regulatory intervention.

The introduction of post-trade anonymity occurred simultaneously to the removal of the default risk and the launch of Express II, a new platform aimed at increasing settlement efficiency. Nevertheless, the overall liquidity improvement is mainly ascribable to post-trade concealment of broker identities, since Hachmeister *et al.* (2010) state that the other two effects that usually accompany the CCP implementation “are only of major importance in futures markets”.

The stocks that seem to have *benefited the most* are *large cap* (less subject to exogenous information asymmetries) and *high depth shares* (less exposed to order anticipation risk) experiencing average spread reduction of 51.45 % and 46.06%, respectively. Thus, the results of the cross sectional analysis would favor the *asymmetric information story* of Rindi (2008) instead of the order anticipation arguments.

My study attempted to replicate the empirical research of Friederich and Payne (2011) who analyzed the equity trading platform SETS of LSE around the introduction of a Central Counterparty system in 2001.

Their analysis highlighted a reduction of almost 20% in inside spread at the best and fifth limit price and an increase in the cumulative depth up to the fifth best price.

Friederich and Payne found strong evidence in favor of the order anticipation hypothesis. In fact, small cap (whose characteristics enable the easily identification of repeated traders) and least depth stocks (more likely to exert price pressure) saw the greatest liquidity improvements.

Furthermore, large and repeatedly trading investors enjoyed the greatest welfare increase because of the reduced market impact produced by their trades. Finally, as the anticipation theory postulates, the data showed large broker-dealer order flow concentration and positive correlation in direction.

The database used didn't provide sufficient information to test all the implications of order anticipation arguments and so I cannot exclude them with certainty. However, one

explanation of why a different theory might explain the liquidity improvement in Nuovo Mercato is a lower degree of order flow concentration.

In fact, at the time of the event the top 5 intermediaries held an average market share of 36.4% (vs. 54% in SETS) and the top 10 intermediaries held an average market share of 57.4%⁷¹ (vs. 77,5% in SETS).

⁷¹ The data were reported on “Fatti & Cifre 2004 of Borsa Italiana”, p.77

CONCLUSIONS

This thesis has focused on the third dimension of market transparency, i.e. anonymity, which concerns the information about the identity of brokers submitting orders either pre- or post-trade.

More specifically, I assessed the *impact that the introduction of post-trade anonymity* (the concealment of intermediary ID codes after trade) in Nuovo Mercato of Borsa Italiana had *on liquidity*, measured as inside spreads. This change occurred on 26 January 2004, following the implementation of a Central Counterparty system.

Since the identity of brokers entering orders to the trading book has never been disclosed, after the event trading became completely anonymous.

This revolution involved also Mercato Telematico Azionario which, however, underwent at the same time the introduction of order book anonymity. Thus, it was not possible to isolate the effect of post-trade anonymity on MTA's market quality.

In conducting the empirical analysis, I relied on the work of Friederich and Payne (2011) who studied the policy implications in the equity trading platform SETS of London Stock Exchange.

Their findings highlighted a reduction of almost 20% in inside spreads at the best and fifth limit price and an increase in the cumulative depth up to the fifth best price

Friederich and Payne found evidence of the order-anticipation theory: small cap (whose characteristics enable the easily identification of repeated traders) and least depth stocks (more likely to exert price pressure) experienced the largest liquidity improvements.

Furthermore, large and repeatedly trading investors enjoyed the greatest welfare increase because of the reduced market impact produced by their trades. Finally, as the anticipation theory postulates, the data showed large broker-dealer order flow concentration and positive correlation in direction.

My empirical study suggests an *overall narrowing of inside spreads* following the introduction of post-trade anonymity. The stocks that benefited most are *large cap* (less subject to exogenous information asymmetries) and *high depth shares* (less exposed to order anticipation risk) experiencing an average spread reduction of 51.45% and 46.06%, respectively.

These results are consistent with the *asymmetric information* argument used by Rindi (2008).

Another evidence against the order anticipation hypothesis is represented by the fact that at the time of the event Nuovo Mercato was characterized by a *low degree of order flow concentration*. In fact, the top 5 intermediaries held an average market share of 36.4% (vs. 54% in SETS) and the top 10 intermediaries held an average market share of 57.4% (vs. 77,5% in SETS).

Thus, relying exclusively on inside spreads, the concealment of broker identities appears to have boosted liquidity, thereby improving market quality.

This result is not surprising if we think that Nuovo Mercato at the time of the event was characterized by high levels of pre- and post-trade transparency.

This is in line with what stated by Matthias Levin, former fellow of the Center for European Policy Studies: “*Overall, transparency is no panacea and there is ‘disquieting evidence’ that too much transparency may harm market quality, as it effectively disables some liquidity provision*”.

All the conclusions have been drawn relying on the fact that the change in liquidity is mainly ascribable to the increased level of anonymity. According to Hachmeister *et al.* (2010) this is not unreasonable because the other two effects generally triggered by the CCP implementation, i.e. removal of default risk and enhancement of settlement efficiency, are particularly beneficial for futures market rather than for equity markets.

An interesting extension of the study would be to test the implications on bid-ask spreads at the fifth limit price and the depth available up to these spreads.

Furthermore, future research might study how the introduction of post-trade anonymity affected the impact that trades have on subsequent prices and the execution costs of worked orders.

In this way, the empirical research of Friederich and Payne (2011) would be entirely replicated and we would be more confident about what theoretical argument could explain the liquidity improvement in Nuovo Mercato.

REFERENCES

- Acker, D., Stalker, M., Tonks, I., (2002), “Daily Closing Inside Spreads and Trading Volumes Around Earning Announcements”, *Financial Markets Group*, London School of Economics.
- Admati, A. R., Pfleiderer, P., (1991), “Sunshine trading and Financial Market Equilibrium”, *The Review of Financial Studies*, Volume 4, No. 3, pp. 443-481.
- Austin, P. C., (2011), “An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies”, PMC US National Library of Medicine – National Institutes of Health.
- Barclay, M. J., Hendershott, T., McCormick, D. T., (2001), “Electronic Communications Networks and Market Quality”.
- Benhamou, E., Serval, T., (1999), “On the Competition between ECNs, Stock Markets and Market Makers”.
- Benveniste, L. M., Marcus, A. J., Wilhelm, W. J., (1992), “What’s special about the specialist?”, *Journal of Financial Economics*, Vol. 32, pp. 61-86.
- Bessembinder, H., Panayides, M., Venkataraman, K., (2009), “Hidden liquidity: An analysis of order exposure strategies in electronic stock markets”, *Journal of Financial Economics*, Vol. 94, pp. 361-383.
- Bloomfield, R., O’ Hara, M., (1999), “Market Transparency: Who Wins and Who Loses?”, *The Review of Financial Studies*, Vol.12, No. 1, pp. 5-35.
- Board, J., Sutcliffe, C., (1996), “Trade Transparency and the London Stock Exchange”, *European Financial Management*, Vol. 2, No. 3, pp. 355-365.
- Board, J., Sutcliffe, C., (2000), “The Proof of the Pudding: The Effects of Increased Trade Transparency in the London Stock Exchange”, *Journal of Business Finance & Accounting*, 27(7) & (8).
- Boehmer, E., Saar, G., Yu, L., (2005), “Lifting the Veil: An Analysis of Pre-trade Transparency at the NYSE” , *Journal of Finance*, Vol. LX, No. 2.
- Borsa Italiana, BitStat – Statistiche mensili, Dicembre 2003.
- Borsa Italiana, BitStat– Statistiche mensili, Anno 2004.
- Borsa Italiana, Fatti & Cifre della Borsa Italiana, 2003.
- Borsa Italiana, Fatti & Cifre della Borsa Italiana, 2004.
- Borsa Italiana, Filippa L., 7 maggio 2004, “Dati e statistiche dei mercati Bit”.

Borsa Italiana – London Stock Exchange Group, January 2014, “Italian Equity Markets – Liquidity, Transparency and Efficiency”.

Buckley, J., Shang, Y., (2003), “Estimating Policy and Program Effects with Observational Data: The “Differences-in-Differences” Estimator”, *Practical Assessment, Research & Evaluation*, 8(24).

Comerton-Forde, C. (2004), “A Review of Stock Market Infrastructure”, ResearchGate.

Comerton-Forde, C., Frino, A., Mollica, V., (2005), “The impact of Limit Order Anonymity on Liquidity: Evidence from Paris, Tokyo and Korea”, *Journal of Economics and Business*, pp. 528-540.

Comerton-Forde, C., Putnins, T. J., Tang, K. M., (2011), “Why Do Traders Choose to Trade Anonymously?”, *Journal of Financial and Quantitative Analysis*, Vol. 46, No. 4, pp. 1025–1049.

Comerton-Forde, C., Tang, K. M., (2009), “Anonymity, Liquidity and Fragmentation”, *Journal of Financial Markets* 12, pp. 337–367.

Chakravarty, S., (2001), “Stealth-trading: Which traders’ trades move stock prices?”, *Journal of Financial Economics*, Vol. 61, pp. 289-307.

Chakravarty, S., McConnell, J. J., (1999), “Does Insider Trading Really Move Stock Prices?”, *Journal of Financial and Quantitative Analysis*, Vol. 34, No. 2.

Croissant, Y., Millo, G., “Panel Data Econometrics in R: The plm Package”.

De Frutos, M. A., Manzano, C., (2013), “Market Transparency, Market Quality and Sunshine Trading”, Department of Economics, Universitat Rovira i Virgili.

Duong, H. N., Kalev, P. S., (2014), “Anonymity and the Information Content of the Limit Order Book”, *Journal of International Financial Markets, Institutions and Money*, Vol. 30, pp. 205-219.

Dwyer, P., Borrus, A., “Fight of Its Life”, *Business Week*, August 11, 2003.

Eom, K. S., Ok, J., Park, J., (2007), “Pre-trade transparency and market quality”, *Journal of Financial Markets*, Vol. 10, pp. 319-341.

Ferrarini, G., (1999), “The European Regulation of Stock Exchanges: new perspectives”, *Common Market Law Review* 36, pp. 569-598.

Financial Services Authority, (2006), “Trading Transparency in the UK Secondary Bond Markets”, Feedback Statement 06/04.

Fong, K. Y. L., Gallagher, D. R., Lee, A. D., (2014), “Individual Investors and Broker Types”, *Journal of Financial and Quantitative Analysis*, Vol. 49, No. 2, pp. 431-451.

Foucault, T., Moinas, S., Theissen, E., (2007), “Does Anonymity Matter in Electronic Limit Order Markets?”, *Oxford University Press*.

- Friederich, S., Payne, R., “Trading Anonymity and Order Anticipation”.
- Friederich, S., Payne, R., (2011), “Trading Anonymity and Predatory Behaviour”.
- Frino, A., Johnstone, D., Zheng, H., (2010), “Anonymity, Stealth Trading, and the Information Content of Broker Identity”, *The Financial Review* 45, pp. 501-522.
- Garfinkel, J. A., Nimalendran, M., (2003), “Market Structure and Trader Anonymity: An Analysis of Insider Trading”, *Journal of Financial and Quantitative Analysis*, Vol. 38, No. 3.
- Gemmill, G., (1996), “Transparency and Liquidity: A Study of Block Trades on the London Stock Exchange under Different Publication Rules”, *The Journal of Finance*, Vol. LI, No 5.
- Gu, A.Y., (2005), “A Survey of the World’s Top Stock Exchanges’ Trading Mechanisms and Suggestions to the Shanghai Stock Exchange”.
- Gozluklu, A. E., (2012), “Pre-Trade Transparency and Informed Trading: An Experimental Approach to Hidden Liquidity”.
- Gozluklu, A. E., (2014), “Pre-Trade Transparency and Informed Trading: Experimental evidence on undisclosed orders”.
- Gruppo Borsa Italiana, Toscani, D., Bosetti, L., 8 maggio 2004, “Struttura e Funzionamento dei Mercati Azionari di Borsa Italiana”.
- Hachmeister, A., Schiereck, D., (2010), “Dancing in the dark: Post-trade Anonymity, Liquidity and Informed Trading”, *Review of Quantitative Finance and Accounting* 34, pp.145–177.
- Harris, L. E., (1997), “Order exposure and parasitic traders”, Marshall School of Business, University of Southern California.
- Ho, D. E., Imai, K., King, G., Stuart, E. A., (2011), “MatchIt: Nonparametric Preprocessing for Parametric Causal Inference”, *Journal of Statistical Software*, Vol. 42, Issue 8.
- Imbens, M. G., Wooldridge, M. J., (2007), “What’s New in Econometrics? Difference-in-Differences Estimation”, Lecture 10.
- Imbens, M. G., Wooldridge, M. J., (2008), “Recent Developments in the Econometrics of Program Evaluation”, National Bureau of Economic Research.
- International Organization of Securities Commissions, (2001), “Transparency and Market Fragmentation”.
- Lecce, S., Mistry, M., Segara, R., Wong, B., (2009), “Does broker anonymity hide informed traders?”, *Discipline of Finance*, Faculty of Economics and Business University of Sydney, NSW, Australia.
- Lepone, A., Mistry, M., (2011), “The Information Content of Undisclosed Limit Orders Around Broker Anonymity”, *Australasian Accounting, Business and Finance Journal*, Vol.5, Issue 1, Article 2.

- Linnainmaa, J. T., Saar, G., (2012), “Lack of Anonymity and the Inference from Order Flow”, *Oxford University Press*.
- Madhavan, A., (1995), “Consolidation, Fragmentation, and the Disclosure of Trading Information”, *The Review of Financial Studies*, Vol. 8, No. 3, pp. 579-603.
- Madhavan, A., (1996), “Security Prices and Market Transparency”, *Journal of Financial Intermediation* 5, pp. 255-283, Article No.15.
- Madhavan, A., (2000), “Market Microstructure: A survey”, *Journal of Financial Markets* 3, pp.205-258.
- Madhavan, A., Porter, D., Weaver, D., (2005), “Should securities markets be transparent?”, *Journal of Financial Markets*, Vol. 8, pp. 266-288.
- Majois, C., (2008), “Anonymity in a Limit-Order Market: An Experimental Analysis”.
- Markets in Financial Instruments Directive (MiFID I) – Directive 2004/39/CE.
- Markets in Financial Instruments Directive (MiFID II) – Directive 2014/65/UE.
- NASDAQ NORDIC Member Rules, Version 2.7, May 4, 2015.
- NOREX Alliance, “Survey on counterparty information in pre-trade”, March 1, 2005.
- Office of Fair Trading, (1995), “Annual Report of the Director General of Fair Trading”.
- Pagano, M., Röell, A., (1996), “Transparency and Liquidity: A Comparison of Auction and Dealer Markets with Informed Trading”, *The Journal of Finance*, Vol. LI, No. 2.
- Pham, T. P., (2015), "Broker ID transparency and price impact of trades: evidence from the Korean Exchange", *International Journal of Managerial Finance*, Vol. 11 Iss 1, pp. 117–131.
- Pham, T. P., Westerholm, P. J., Discussion Paper 2013-14, “A Survey of Research into Broker Identity and Limit Order Book“, UTAS School of Economics and Finance.
- Pham, T. P., Westerholm, P. J., Discussion Paper 2013-12, “An international trend in market design: Endogenous effects of limit order book transparency on volatility, spreads, depth and volume”, UTAS School of Economics and Finance.
- Petersen, M. A., (2008), “Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches”, *Oxford University Press*.
- Randolph, J.J., Falbe, K., Manuel, A. K., Balloun, J. L., (2014), “Step-by-Step Guide to Propensity Score Matching in R”, Practical Assessment, Research & Evaluation.
- Regolamento del Nuovo Mercato Organizzato e Gestito da Borsa Italiana S.p.A., deliberato dall’Assemblea di Borsa Italiana S.p.A. del 23 settembre 2004 e approvato dalla Consob con delibera n. 14735 del 12 ottobre 2004.

Rindi, B., (2008), “Informed Traders as Liquidity Providers: Anonymity, Liquidity and Price Formation”, *Review of Finance* 12, pp. 497–532, *Oxford University Press*.

Saporta, V., Trebeschi, G., Vila, A., (1999), “Price Formation and Transparency on the London Stock Exchange”, Bank of England.

Security and Exchange Commission, Notice of Filing of Proposed Rule Change by the National Association of Securities Dealers, Inc. Relating to a Post-Trade Anonymity Feature in SuperMontage, *Federal Register*, July 2, 2003, Vol. 68, No. 127, Notices.

Securities and Exchange Commission, Order Approving Proposed Rule Change by the National Association of Securities Dealers, Inc. Relating to a Post-Trade Anonymity Feature in SuperMontage, *Federal Register*, September 30, 2003, Vol. 68, No. 189, Notices.

Securities and Exchange Commission, (2013), “Equity Market Structure Literature Review - Part I: Market Fragmentation”.

Securities and Exchange Commission, (1994), “Market 2000: An Examination of Current Equity Market Developments”.

Seppi, D. J., (1990), “Equilibrium Block Trading and Asymmetric Information”, *The Journal of Finance*, Vol. XLV, No. 1.

Skjeltorp, J. A., Sojli, E., Tham, W. W., (2011), “Sunshine trading: Flashes of trading intent at the NASDAQ”.

Stuart, E. A., (2010), “Matching methods for causal inference: A review and a look forward”, PMC US National Library of Medicine – National Institutes of Health.

Torres- Reyna, O., (2010), “Getting Started in Fixed/Random Effects Models using R”, Princeton University.

Theissen, E., (2003), “Trader Anonymity, Price Formation and Liquidity”, *European Finance Review* 7, pp. 1-26.

Vasios, M., Payne, R., Nolte, I. (2015), “Profiting from Mimicking Strategies in Non-Anonymous Markets”, MPRA, Paper No. 61710.

Waisburd, A. C., (2003), “Anonymity and Liquidity: Evidence from the Paris Bourse”, Neeley School of Business, Texas Christian University.

<http://www.consob.it>

<http://www.sec.gov/about/whatwedo.shtml>

ACKNOWLEDGEMENTS

This thesis couldn't have been done without the help of some persons.

First and foremost, I would like to express my gratitude to my Supervisor, Professor Cinzia Baldan, for the careful guidance, expertise and the dedication to my development. Whenever I faced problems, she has always been willing to provide me with precious insights for their solutions.

I extend great thanks to Dr. Alberto Ronco, Asset Management Responsible of Giotto Sim S.p.a., for his assistance in collecting the data for the purpose of this thesis.

Finally, a special thanks to my parents and my sister for their unending support and encouragement during my university carrier. Without them, this thesis would not have been possible.