On Liquidity around Large-Block Trades: Upstairs Trading Mechanisms, Price Impacts and Common Factors

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Submitted for the degree of Ph.D. in Economics
University of Lugano, Switzerland

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November 2004

To my parents,

Pie' and Tommino.

In ogni schema ordinato tendente
a comporre il modello della vita umana
è necessario introdurre
una certa dose di anarchia.
Russell Bertrand,
Scritti filosofici

Tutto è questione di misura.
Anonimo

Acknowledgments

Many people deserve my thanks for their part in creating this thesis. I am grateful to professors of my committe for their comments and suggestions to improve my dissertation. I would like to thank professor Giovanni Barone-Adesi, my supervisor, for his encouragements and guidance through my PhD program. His humanity and his understanding of problems helped me to acquire alternative perspectives of doing research. I would like to thank professors Francoise Degeorge and Maurizio Murgia for their suggestions. I am especially grateful to professor Maurizio Murgia for providing helpful insights and vision that improved the quality of my work. I would also like to thank professor Aditya Kaul at the University of Alberta in Canada and professor Giulio Cifarelli at the University of Florence in Italy, who has been highly supportive over the years of my PhD program.

My sincere thanks go to Simona Cain-Polli for her work as editor. She improved my English increasingly.

Financial supports from the Gamma Foundation in Lugano in Switzerland, and Fondazione Cesifin "Alberto Predieri" in Florence in Italy, are gratefully acknowledged.

Many thanks to Borsa Italiana (the Italian Exchange) for providing me with the data used in this dissertation, in particular Luca Filippa, Mauro Medizza and Concetta Ricciardi. Mauro Medizza is helpful for providing insights about block trading at the Italian Exchange.

I am indebted to the following: Fulvio Corsi, Andrea Gigli, Loriano Mancini, Claudio Ortelli, Angelo Ranaldo, Paolo Schmidt, Paolo Tenconi and Ombretta Terazzan. I am in particular grateful to Andrea Gigli and Ombretta Terazzan. Ombretta deserves a special mention for her great patience.

I would like to thank my collegues of the PhD program for making my lifetime in Lugano funny and enjoyable, most especially Francesca Bellini and Ombretta Terazzan. My gratitude goes to my friends of the Peace Camp, in particular Giuliana Tiripelli, Maria Forzieri and Rosanna Masci for their constant encouragement and support.

Finally, I would particularly thank my family for their infinite patience. This dissertation is dedicated to them. I want to thank my Mum for her love and strength, and her courage over years.

My sincere thanks go to all these, and to God for guiding my life, often against my will, through the maze of paths that led me here, where I am very happy to be.

Chwen Chwen Chen

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Introduction

Liquidity is the grease which smooths financial markets. Although it is a widely accepted concept, liquidity is difficult to be defined. Broadly speaking, liquidity is the ability to quickly trade large sizes at prices that are reasonable in relation to underlying demand conditions (Schwartz, 1988). Liquid markets are characterized by immediacy, width and depth. Immediacy refers to the speed at which trades of a given size can be arranged at a given cost. Width refers to the cost of doing a trade of a given size. Related to this latter dimension is depth, which refers to the size of a trade that can be arranged at a given cost. Kyle (1985) identifies another characteristic of liquid markets by introducing the concept of resiliency. Resiliency refers to the time market prices take to revert to their prior level after a large trade.

Recently, liquidity has been receiving increasing consideration from academics, practitioners and regulators because of the steady growth of institutional trading. Institutional trading differs from retail trading for many features. Institutions may pursue the so-called passive trading, which aims to reduce the market impact of portfolio-rebalancing trades by confusing the signal given by an order (see Schwartz and Whitcomb (1988)). Institutional trading differs also from retail trading because these two investor groups may differ in their level of sophistication in response to information. This implies that institutions are smart, or informed traders (the so-called stealth-trading hypothesis, see Barclay et al. (1993) and Chakravarty (2001)). In any case, avoiding the market impact of their orders is a matter of concern to institutions. When trading, institutional investors have to seek a balance between avoiding high immediacy cost by trading too quickly and avoiding high opportunity cost by trading too patiently.

A recent trading pattern which is empirically observed is the increasing size of institutional orders. It is quite often for institutions to place a very large order, under the form of block trades, to be executed in one single step, or to split a very large order in orders of smaller sizes, which cannot be handled in the regulated market anyway.

Large-block trades have been typically handled over the counter in the so-called upstairs market.[1] The wave of reforms which interested most major exchanges worldwide over the past two decades led regulators to introduce innovation and new arrangements to facilitate block trading and meet the requirements of institutional investors, above all immediacy. The process of the creation of desirable markets and trading venues is still ongoing in view of the pressure from institutions themselves, increasing competition amongst different market structures and globalization.

From the viewpoint of the market architecture, institutional trading raises several design issues, which we can outline here only partially. One issue is the fragmentation of order flow that would arise as (a consistent) part of total order flow is handled outside the primary market. This problem becomes more severe as the upstairs market trades the same instrument in larger size than in the downstairs market. Debates have long focused on that upstairs trading might "cannibalize" order flow in the primary market with the result that liquidity migrates to the wholesale market and leave out downstairs market illiquid.

Similarly, take the relationship between the upstairs and the downstairs markets. Kraus and Stoll (1972) point out that this relationship is an important factor in determining the effect of institutions on the structure of securities markets. The less imbalanced institutional trading is, the weak this relationship. At most, there is potential for the development of a "two-tier" market structure, where institutions may incur lower transactions costs. The introduction of automated trading systems for institutions (either within public exchanges or in the form of alternative trading systems) seems to suggest that this might be the further development.

Last but not least, institutional trading has also implications for market efficiency. There is a burgeoning literature focusing on how institutions affect stock returns. In an efficient market, prices always fully reflect available information. Under the standard asset pricing equilibrium model, stock prices will change in response to changes in investors' risk-return preferences and to new information. Investors are sufficiently small and in large number so that each individual investor can take prices as given and can trade any instrument at current

[1] The upstairs market acquired its name because its traders arrange block trades at trading desks in the offices of the wirehouses for which they work. When traders used to have offices that were in the New York Stock Exchange building or across the street, these offices were generally above the street level on which the trading floor was (and still is) located.

prices. In such a framework institutional trading does not affect market price since different securities are perfect substitutes.

Under heterogenous expectations and non-zero transaction costs, different securities are not necessarily perfect substitutes. Large investors' trades may therefore produce a price impact that can adversely influence their investment decisions.

Definitely, one of the challenges regulators must face regards the design of trading rules which allow hidden liquidity or "latent demand" of institutions to come out. Latent demand refers to the willingness of institutions to trade but that is not expressed yet. A typical situation occurs when large traders have to split a single block into pieces and hold their orders back. Upstairs trading appears to be able to tap into this unexpressed trading demand (Grossman, 1990) right because of the role of block intermediaries as depositary of information flow that the downstairs market cannot observe. It responds to the need of institutions to accomplish large block trades in one single step to avoid having their trading strategies leaked.

The objective for this study is to expand the knowledge about the economic role of upstairs markets as source of liquidity for institutional investors. By pinpointing the problems and their possible causes we hope that it may be possible for authorities to change market design and thus improve market liquidity.

To carry out our analysis, in Chapter 1 we present a survey of the microstructure of trading mechanisms for large block trades on the major European equity markets. These include the London Stock Exchange, the Euronext markets (Paris Bourse, the markets of Bruxelles, Amsterdam and Lisbon), the Frankfurter Stock Exchange, the Swiss Exchange, the Italian Exchange and the Madrid Stock Exchange. These stock markets are the largest in Europe in terms of market capitalisation and value of trading and are fairly representative of structural changes which are ongoing throughout European stock markets. As a matter of fact, although each national stock exchange has responded to pressure coming from institutional investors and globalization to create a single pan-European equity market, the way national stock markets respond varies from exchange to exchange. Issues of great matter concern disintermediation of block trading activity, the time about the publication of block trades and the need for any inter-market linkage.

Chapter 2 investigates intraday dynamics of price and liquidity impacts of large-block trades on the Italian Exchange. We focus on the Italian Exchange because, unlike most exchanges worldwide, it enforces no interaction between the upstairs and the regulated markets.

Our analysis would shed light on the functioning of the upstairs market characterized by block brokers although these intermediaries can act in dual capacity. It will provide insights also of the structure of corporate governance. We also investigate whether block trading activity in such a market structure gives rise to common effects.

In Chapter 3 we provide an empirical analysis of intraday and interday variations in block trading activity. The purpose is to uncover any systematic pattern in trading activity of traders that typically place large-block orders. One important implication of the existence of such patterns is that any predictable pattern in asset returns may be exploitable and therefore judged as evidence against efficiency of asset markets. In addition, investors may take advantage of relatively regular shifts in the market by designing trading strategies, which accounts for such predictable patterns. Our study of any systematic variation in block trading activity is crucial to detect possible segmentation in liquidity for institutional trading.

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Chapter 1

The microstructure of block trading in European equity markets: A survey

1.1 Abstract

This paper provides a survey of trading mechanisms for block trading in the largest European stock exchanges. The explosive growth of institutional trading across Europe in recent years is the main factor which spurs competition between European exchanges on the supply side in order to accommodate the increasing demand for appropriate trading facilities from institutions. European exchanges share common features but they also differ importantly in some market design features. Common institutional features include a separate trading arrangement for the handling of block trades, the effort to exclude block prices from the downstairs price discovery and bland requirements in terms of transparency. Significant institutional dissimilarities include the enforcement and the degree of interaction between the upstairs and the central markets, the enforcement of special procedures for block trades and the level of post-trade transparency. In addition, disintermediation of block trading has become a built-in design feature of the public exchange. The resulting institutional fragmentation may also account for the different growth of institutional trading in individual European exchanges. An open issue regards the need or not to formally force interaction in exchanges where broker-dealers already provide some form of price linkage between the upstairs and downstairs markets.

1.2 Introduction

European exchanges have come under increasing pressure from the demand side in the past few years. Institutional investors throughout Europe are pushing for a unified equity market at least for blue chips, as is evident from the various structural changes the European exchanges have undergone in the past decade. One notable market design change is the creation of a separate trading arrangement from the normal order flow to accommodate the trading and the execution of institutional orders ("block trades").

The growth of institutional trading has been consistent across European equity markets. However, the degree of this growth varies considerably from stock market to stock market. The relative attractiveness of a stock exchange over another depends on a number of factors. Tax considerations significantly determine the relative competitiveness of a financial market with respect to others. Among other determinants one is the way the set of rules governing the trading process impacts institutional execution costs. The way a market is designed affects various institutional trading strategies, hence price formation and transaction costs. After all, institutional investors ultimately aim to cut transaction costs, especially implicit trading costs.

The objective of this paper is to account for institutional similarities and dissimilarities of trading rules for institutional transactions in the major European equity markets and to call attention on the fact that institutional differences may lead to regulatory arbitrage across financial markets. This in turn may *also* explain the varying growth of institutional trading on individual European stock exchanges. This paper complements the work by Demarchi and Foucault (1998) since it specifically points to recent changes and new insights into the trading mechanisms for large-block trades across European stock exchanges.

While European public exchanges share common institutional features, differences in trading mechanisms for large blocks are nonetheless quite relevant. Common institutional features include the handling of block trades in a separate trading arrangement (the "upstairs market") and bland requirements in terms of transparency. Institutional dissimilarities concern the enforcement and the degree of interaction rules and hence the way block prices are excluded from price discovery, the enforcement of special procedures for block trades and the level of post-trade transparency. In addition, disintermediation of block trading is becoming a built-in design feature of the public exchange. The resulting institutional fragmentation has led to increasing competition for trading rules between exchanges.

From the European financial integration perspective, institutional fragmentation in the wholesale segment calls for some reflections. Efforts are being made in individual European exchanges to create a pan-European network for the trading on the central market - it is the case for the so called "Market Model"-, however there has been no equivalent initiative for block trading so far. While the European Investment Service Directive is undergoing revision, an issue at stake is whether and to what extent institutional dissimilarities should be removed and who - individual national exchanges or European authorities - should be entitled to do that.

The ability of European public exchanges to offer optimal market design for institutional trading is important also because of increasing competition from proprietary trading systems for this segment of market order flow. These trading systems are able to electronically execute even a million or more shares at once without substantial price impact. Besides, the growing use of trading practices of intermediaries/brokers and dealers (internalisation and order preferencing) induces market fragmentation and consequently reduces overall liquidity. Therefore, European public exchanges are challenged to offer more competitive trading environments not only to enhance market liquidity but to gain profits from serving institutional trades.

This paper is organized as follows. The next section accounts for the state of development of institutional trading in Europe. Section 1.4 reviews the trading mechanisms for blocks in the major European stock exchanges. Section 1.5 presents the main (common and different) institutional design features. Some concluding remarks complete the paper.

1.3 Institutional trading: why the need for separate trading arrangements?

The importance of institutional investors has been steadly increasing in Europe. Davis and Steil (2001) report that only in the period 1990-1998, the value of assets managed by institutional investors grew at an annual rate of 14%. The amount of financial assets held by institutions relative to GDP has ever increased over time (Figure 1.1). The total value of funds under management in Europe is over $10 billion, of which the United Kingdom accounts for 40% (Table 1.1). This trend, however, is far from uniform. The growth of institutional trading appears to be more significant in continental European markets than in the U.S. and U.K. markets. Most continental European markets are still contestable markets for domestic institutions and foreign intermediaries; they therefore ensure excess profitability.

The rising need for retirement benefits of a rapidly ageing population, combined with the recognition that pay-as-you-go pension systems are unsustainable as they stand, have largely contributed to the steady expansion of institutional trading in Europe. Notable characteristics of this overall phenomenon include the trend toward professional management of household assets, the shift of portfolios to equities and foreign assets, and the move from defined benefit to defined contribution pensions in private sectors. Although these factors are present elsewhere, European countries are among those that have the greatest scope for growth in this respect because of less well developed mutual funds sectors, ongoing pay-as-you-go pension systems, and little funding (except in the United Kingdom, Ireland, Denmark, the Netherlands, Sweden and Switzerland). More generally, owing to the dominance of pay-as-you-go pensions, scope for expansion is arguably even greater than in the relatively mature markets of the United States and the United Kingdom, where pension systems already have major funded elements. Institutional saving is also likely to increase sharply over the next 20 years as individuals seek investment opportunities for their retirement.

The growing weight of institutional trading in the market order flow has had a great impact on the market design of European equity markets. European exchanges have moved along two directions to accommodate the growing demand of trading facilities from institutions. On the one hand, an off-market trading venue is arranged for the handling of block trades. This responds to the need for institutions and block traders to have their orders executed away from the public order book to prevent excessive front-running and mitigate price impact. On the other hand, most exchanges - also in an effort to consolidate the order flow into the central market - offer institutional investors the opportunity to trade within the central trading system the total size of block transactions by means of hidden orders.

The design of the trading mechanism for large block transactions is problematic because block ("upstairs") markets trade the same instruments as regular ("downstairs") markets do.[1] Regulators must consider the interrelation between the two types of markets with each other for the benefit of all market participants. To institutional investors, exchanges must ensure that institutional orders execute fast and at the lowest possible total trading costs.[2] To the participants of the regulated market, regulators concern for the negative externalities that large transactions induce on the central market. Regulators must ensure that blocks do not drain liquidity from the normal market order flow by creating temporary liquidity shortage for the order book users. A typical situation is that, while downstairs' investors try to seek a counterpart in the transaction of a security, at the same time a deal of larger volume on the same security is being executed on the block market. The central market would therefore become illiquid. More harmful effects would follow if large trades were even information-motivated, and consequently the market could become inefficient.

The way exchanges design trading protocols for large transactions is particularly relevant for European public exchanges while the financial integration process is becoming tighter. European public exchanges will certainly have to cope with increasing mutual competition in the wholesale

[1] The upstairs market is an off-exchange market where buyers and sellers negotiate in the "upstairs" trading room of brokerage firms. The downstairs market is the exchange floor or its electronic counterpart.

[2] Total trading costs include explicit and implicit trading costs. Explicit trading costs include transaction fees (exchange fees and intermediaries commissions). Implicit trading costs include the bid ask spread, market impact, timing costs and opportunity costs. The bid ask spread refers to the costs in the amount of the half the bid/ask spread. Market impact occurs when the price effect induced on the demand side when the order volume exceeds the current best bid and best ask prices; for suppliers of liquidity it consists of market reaction upon disclosure of the order in the market. Investors incur also possible price movements, if the order is held back due to a possible positive or negative market impact (timing costs). Opportunity costs are lost revenue in the trading strategy, if the order is not placed, due to market impact/timing costs.

segment and from proprietary trading systems; on top of that, they will have to compete against top European authorities for the definition of common regulatory setting.

1.4 Block trading mechanisms in Europe

This section provides a description of the set of rules governing block trading on the major European stock exchanges in terms of market capitalisation and value of equity trading: the London Stock Exchange, the Euronext markets, the German Exchanges, the Italian Exchange, the Swiss Exchange and the Spanish Exchanges,[3] as shown in Figure 1.2 and Table 1.2. The focus on these specific exchanges allows for a quite broad picture of block trading mechanisms in Europe. The London Stock Exchange still predominates over the European continental exchanges, though this superior position has come under pressure from the Euronext markets and in lesser extent from German markets. Trading in the London market is still largely characterised by off-market trades, which include notably foreign securities, as Table 1.4 shows. Note, however, the increasing importance of the German exchanges as centres for the supply of liquidity for foreigh securities traded off-market.

1.4.1 The London Stock Exchange

The London Stock Exchange came under two important reforms (in 1986 and 1997) which changed its long-established pure dealership system into a hybrid trading arrangement. Trades can be executed electronically though the SETS order book (for domestic securities; the International Order Book for international securities) or off the order book with dealers using SEAQ (for domestic securities; SEAQ International for foreign securities) which displays market makers' prices. In addition, a hybrid trading system (SEATS) is provided for domestic securities.

Such a market organization clearly leads to order flow fragmentation. Actually, over 50% of volume is executed away from the electronic order book (Demarchi and Foucault, 1998). This concerns very small and very large trades (Gajewski and Gresse, 2003, and Friederich and Payne, 2002). The ability of dealers as suppliers of immediacy is very crucial to institutional orders increasing consistently in size. For the London market, the size of institutional trades ranges from 3 Normal Market Size (NMS)[4] to

[3]Pagano and Steil (1996), Pagano (1998), Biais (1998) and Demarchi and Foucault (1998) give an exaustive description of the most important changes of the microstructure of the respective downstairs markets in past decades.

[4]A Normal Market Size (NMS) for a stock is roughly 2.5% of the average daily trading volume for the same stock. For a transaction to be eligible as a block the London Stock Exchange requires the transaction to be larger than some thresholds computed on the basis of the NMS. A transaction is allowed to use the block trade facility if it is: a) larger than 75 times the NMS of 2,000 shares or above; b) 50 times NMS of 1,000 or 500 shares. A transaction of any European security can be elected to use the block trade facility if it is

above 5 NMS (Schwartz and Steil, 1996). Trades of this size can be handled *en-bloc* and cost-effectively only in a dealer market.

Block trades are mainly "worked" over the market trading session (09:00 A.M. - 5:00 P.M.). The reason is that over off-exchange trading hours there are few reference prices for market makers, therefore blocks traded outside the exchange hours take place on other markets that are open.

Since the introduction of SETS in 1997, when member firms were allowed to act as principals for all order sizes, large trades (> 8 Normal Market Size) in SETS regarding a single stock or a portfolio transaction (20 securities) are subject to a special procedure, the Worked Principal Agreement (WPA). Under a WPA, a member firm acting as principal and its client agree to execute, at some point in the future, a large trade. The price and size of the trade are determined at the time of agreement but the member firm can offer price and/or size improvement.

1.4.2 Euronext markets (the Paris Bourse, the Exchanges of Amsterdam, Bruxelles and Lisboa)

Euronext markets consists of an integrated trading platform for the cash markets of the former Paris Bourse, the exchanges of Amsterdam, Brussels and (in 2002) Lisboa. The common trading platform has been operating since 2001 and is based on the French trading system, the Nsc (Nouveau Système de Cotation). A number of market rules have been also harmonized across the Euronext market undertakings and apply equally to all Euronext markets involved. Other market rules, for instance the listing requirements, remain within the competence of each Euronext market undertaking in view of a coming process of harmonization.

Table 1.5 shows the distribution of order book and block trades in cash segment for individual Euronext markets. Euronext Paris has been and remains the most important source of liquidity for institutional investors. Note that the Amsterdam exchange accounted for more consistent blocks trading activity prior to the merger than subsequently. While this depends on a number of factors, a possible factor may the more flexible trading rules in force prior to the merger. Actually block transactions on the Amsterdam exchange were conducted in various ways in the wholesale market. Orders could be executed either directly, with a counterpart outside the central limit order book, or against the central limit order book. No price links were enforced between the prices in the wholesale and in the retail segment.

The current trading rules governing the handling of block trades on Euronext markets are very detailed and composed. The amount of the minimum block thresholds (the Normal Block Size, or "NBS")[5] vary depending on the phase the stock is traded (continuous or auction) and its liquidity.

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qualified as such on a regulated European market. More generally, for an international security traded on the International Order Book, the threshold is above 50 times the NMS.

[5]The NBS is the minimum order size for an order to be eligible as a block trade. For each stock, it is

Block trades are prematched under two forms. Prearranged trades can be executed between or at the current best bid and ask prices on the order book. These are called "applications". A block also can be traded outside the current spread, but then the "clear the book" rule must be observed. This rule varies depending on whether the block is ordinary or structural. Within ordinary block trades, if the amount of the block trade is less than 5 times the relevant NBS, block prices must be within the Weighted Average Spread (WAS).[6] They are nonetheless allowed to fluctuate from 5% below the best bid limit price to 5% above the best ask limit price displayed in the central limit order book. In case the amount of the block trade is equal or greater than 5 times the relevant NBS, the WAS need not be respected. Then the allowed price is 5% around the last traded price on the central order book, during or outside the trading session.

Structural block trades are defined as those block trades whose amount of the block trade is equal or greater than 5% of market capitalization of the company whose stock is being traded. In this case a spread of 10% (by referring to the last traded price on the central limit order book) is allowed.

1.4.3 German Exchanges: the Frankfurt Exchange (Frankfurter Wertpapierbörse)

A main feature of Germany is that trading takes place on eight different stock exchanges: Berlin, Bremen, Düsseldorf, Frankfurt, Hamburg, Hanover, Munich and Stuttgart. Among the eight exchanges Frankfurt (Frankfurter Wertpapierbörse, FWB) is by far the largest. We therefore focus on the description of the trading protocol on the Frankfurter Stock Exchange, also because of the innovations

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roughly at least equal to 2.5% of the average daily trading volume in the last quarter and equal to 7.5 times the average depth at the best bid and ask prices in the last quarter.

[6]The Weighted Average Spread is the difference between a weighted average of the best ask prices and a weighted average of the best bid prices up to the Normal Block Size. The WAS is computed as follows. Suppose the NBS for a stock is 10000 shares and the limit order book is as follows:

Buy side (B)		Sell Side (S)	
Qt	Price	Price	Qt
3 000	10	11	4 000
5 000	9	12	7 000
4 000	8	13	2 000

So the WAS is computed as follows :

B: (3 000*10 + 5 000*9 + 2 000*8)/10 000 = 9.1

S: (4 000*11 + 6 000*12)/10 000 = 11.6

WAS = 11.6 - 9.1 = 2.5

For very large trades (> 5NBS), the computation of SuperWAS (the WAS enlarged) is allowed by request.

for block trading this Exchange introduced.[7]

The trading of small-medium size orders takes place in a hybrid form: orders are routed to a specialist, the "Skontoführer" (formerly "Kursmakler")[8] by brokers on the floor or through the exchange electronic order routing system Xetra.

The trading of large-block transactions was characterized by off-exchange and OTC transactions. In March 2001 the FWB introduced Xetra XXL, an exchange-based, fully electronic block trading on Xetra. The current version of Xetra XXL dated to November 2001 with major innovations in terms of transparency.[9]

Xetra XXL represents an innovative trading model for large-block transactions with respect to traditional broker/dealer-intermediated negotiations. Block trading takes place in a call auction market where orders are routed to an electronic closed order book. The call auction consists of predefined crossing periods based on a crossing schedule, each consisting of a crossing's pre-call phase and a crossing's call phase with random end. Over the crossing period the current crossing price (the midpoint of the spread computed on the basis of the order book information on Xetra) is continously displayed. Large-block orders are matched according to size priority rules at the crossing price available in that time.

After the start of a crossing period, the change of a crossing pre-call phase to a crossing call phase is triggered by the submission of "tradable orders". "Tradable orders" are market buy (sell) orders or limit buy (sell) orders equal to or lower (higher) than a predetermined threshold defined by the exchange based on the current midpoint. The definition of such a "trigger corridor" is meant to prevent traders from manipulating customers' orders. The change of the trading phase from pre-call to call may occur immediately at the start of the crossing period or within the crossing period. If there are no order entries or orders not fulfilling the above criteria, the crossing period ends without switching into the crossing call phase.

The electronic order book is completely closed over the crossing auction. What the market observes is the phase change from the pre-call phase to the call phase as a tradable order is submitted and real time information on the existence of a block order is available continously through the screens of the systems and of data vendors.

With respect to intermediated trading arrangements, Xetra XXL shows a great number of advantages. First, search costs for counterparts and broker commissions are reduced to a minimum.

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[7] Theissen (2003) provides a detailed description of the microstructure of the German Equity Markets.

[8] This broker-dealer has exclusive access to the limit order book. Unlike the NYSE specialist he is not obliged to trade for his own account.

[9] Xetra XXL has been successful with institutional investors since its launch. Exchange officials told us that comparing the year 2001 and 2002 so far, there was an increase in turnover of 1975% and 200% in trades for the block market.

Xetra XXL is designed to explicitly reward the provision of liquidity: no exchange fees are charged to executed market and limit orders which trigger a call phase. Further, Xetra XXL reduces the risk due to price and execution uncertainty of institutional orders since block trades execute at the midpoint quote of the current spread of the reference market. In case of an imbalance of buy and sell volume, orders are matched according to volume/time priority. The indication to the market of the existence of block orders per stock enables market participants to signal their intent to trade without generating market impact. Lastly, block orders provide no contribution to price discovery. In the context of block crossing, order limits serve only as execution conditions and orders are only good-for-day.

1.4.4 The Italian Exchange (Borsa Italiana)

The Italian Stock Exchange has been long characterized by a very large off-exchange trading volume mainly because of the existence of statutory fixed commissions on the exchange. By the concentration rule introduced in 1991 (the SIM law), the trading of small-medium size orders has been consolidated in an electronic limit order book, while large trades take place off-exchange. Table 1.6 provides a historical perspective of retail and block trading at the Milan Stock Exchange after the 1991 financial reforms.

On the Italian Stock Exchange, off-exchange trades, which include blocks and transactions called “fuori mercato” transactions, must be viewed as an exception to the concentration rule. Transactions can take place off-exchange provided they are executed through a prior written authorization by the client and at a *better price* than one could obtain on-market (best execution principle). The meaning of “better price” is not immediately clear, though. The implication of “better price” is that there exists an objective and easily verified parameter with respect to which an investor can always compare the price he obtains off-exchange with those existing on the central market. This parameter cannot easily be verified, of course, and is certainly not objective (Steil, 1996). A question is how to compare prices across markets unless the investor is demanding the same service. However, allowing for a broader interpretation of the “better price” principle, it may be that the ”better price” (even best price) is seen as better (or even best) by the client. This price may be worse than those prevailing on the central market, though the client may held it as the better price he can achieve for himself (Trovatore, 2001). The motivation underlying the best execution principle is that better prices may be attained through private negotiations.

Unlike *fuori mercato* transactions, for an off-exchange transaction to be eligible as a block transaction, block thresholds must be met. The block thresholds, which are updated every six months on the basis of the average daily turnover of the previous six months, have steadly grown.[10] On the

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[10]Up to date there are three minimum block size thresholds:

- not less than 150,000 Euro for stocks with an average daily turnover of less 1,5 millions Euro

- not less than 250,000 Euro for stocks with an average daily turnover between 1,5 and 3 millions Euro one hand, this may reflect the increasing average volume and size of institutional trades and on the other, the effort of Italian regulators to disincentivate off-exchange trading in order to consolidate the central market order flow. Gottardo and Murgia (2000) report that on the Italian Stock Exchange block traders rarely commit their own capital in block transactions because of the considerable capital amount required.

These market rules are the result of the particular view Italian regulators have about the upstairs market. The upstairs market at the Italian Stock Exchange is somehow peculiar from the regulatory perspective with respect to upstairs markets of other European exchanges because that upstairs market is indeed not regulated, that is block transactions are viewed as not giving rise to a pure block market; rather, large transactions should be considered as individual operations negotiated off regulated markets within the general regulatory environment stated in this issue by the Italian regulators.[11] The structure of the upstairs market is therefore more broker- than dealer-based with a view to avoiding any kind of manipulation deriving from the conflict of interests of upstairs intermediaries in serving as dealers.

1.4.5 The Swiss Stock Exchange

The Swiss Exchange allows for individual orders larger than CHF 200,000 to be executed off-system. For these trades, the Exchange offers a trading facility that enables a form of electronic negotiation. Using this facility a member can make a Statement of Interest that indicates to the other members, in a non-binding manner, that he or she would like to trade in a certain stock. Members can also direct an Addressed Offer to a specific member (or to several specific members), which can then be accepted, ignored or rejected. In any case, for a large transaction to be executed as a block the member firm itself must take on the position risk.

By exchange rules, off-system trades must be executed at prices prevailing in the central market at the time of trading (Best Execution Principle).

1.4.6 Spanish Exchanges: the Madrid Stock Exchange (Bolsa de Madrid)

In recent years the Spanish security market has undergone significant reforms which have led the Spanish stock market to be ranked among the most active European stock exchanges. The market has acquired its international character over time by offering European investors an integrated platform to trade the shares of the leading Latin-American companies. Although trading takes place in four

- not less than 500,000 Euro for stocks with an average daily turnover between 3 and 10 millions Euro
- 1,5 millions Euro for stocks with an average daily turnover greater than 10 million Euro.

[11] We thank Luca Filippa at the Borsa Italiana for this clarification.

regional exchanges (Madrid, Bilbao, Barcelona and Valencia), the electronic order book, SIBE,[12] introduced in November 1995, allows the four Spanish stock markets to drive their orders through terminals connected to the mainframe. Trading can also take place in the open outcry trading system on the floor of the Madrid Exchange, though it accounts for less than 2% of total trading. Because of its importance, we focus henceforth on the Madrid Exchange.

The Madrid Exchange provides two trading facilities for block trades, depending on the liquidity of the securities and on whether the trading takes place over or out of the normal trading hours. There are two procedures for blocks trading during the normal trading session. Under the "blocks on agreed terms" procedure, which concerns block trades of the most liquid stocks, the effective block volume must be more than Euro 600,000 and 2.5% of the average daily trading volume of the share in the last quarter; the block price is allowed to range between +/- 1% over the average bid-ask price. These block trades are previously matched. More severe conditions are required for block trades of other shares, since the trading volume required is of more than Euro 1.2 million and 5% of the daily average over the last quarter. Block prices may vary within 15% range on the reference price (blocks with parameters).

Block transactions conducted out of normal trading hours (from 5:40 P.M. to 8:00 P.M.) are carried under the "special operations" procedure. This procedure regards mostly block trades of shares traded in the floor system. Special operations are carried out at an agreed price between market members or between a market member and the client or between two clients of the same market member. There are two types of "special operations". Block trades with effective volume of more than Euro 300,000 and 20% of the daily average traded over the last quarter, are only required to be communicated after the conclusion of the trade (communicated special operations). The block price is allowed to range within 5% of the closing price or the average weighted price. In case the block volume amounts more than Euro 1.5 million and 40% of the daily average traded volume, a prior authorization is required to the Trading and Monitoring Commitee (authorised special operations). In addition, if the operation is directly agreed between non-market members, a market member must validate it.

1.5 Institutional similarities and dissimilarities

In this section we consider the institutional common features and differences in the basic design features of block trading systems of the six European stock exchanges surveyed in the previous section. It is not easy to distinguish between institutional features that are shared and those that are not, because some common institutional features themselves share remarkable institutional differences. We identify some basic aspects in block trading mechanisms and for each design feature we outline similarities and

[12]SIBE is the acronym for Sistema de Interconexión Bursátil Español (Spanish Stock Market Interconnection System).

dissimilarities across exchanges. We identify five basic features:

- enforcement of specific trading procedures for block trades
- exclusion of block prices from price discovery
- transparency
- intermediated vs nonintermediated block trading
- enforcement of interaction rules

Table 1 in the Appendix provides a summary of the design features regarding price and publication of the trading mechanisms for large-block trades in the European equity markets previously surveyed.

1.5.1 Enforcement of special procedures for block trades

Unlike the central market, the off-market is not a regulated market. Its regulation is made difficult because by the nature of the trading itself as well by the frequency of deals. Although large-block trades are arranged in a separate trading venue within the general trading environment of the public exchange, the degree of the regulation of off-exchange trades differs across European exchanges. Some exchanges formally set up special procedures that block traders must observe over the negotiation of block trades. These procedures generally consist of an agreement between the counterparts before the block trade so that all the trade terms are clear and well known to all parties involved. Block trades with an amount larger than a predefined threshold even require prior authorization from the Exchange trading authorities. These special procedures may be seen in the applications on Euronext markets, the WPA for securities trading on SETS on the London Stock Exchange, the Statement of Interest in the SWX, and the various procedures in force on the Madrid Exchange. No special trading procedure is provided on Xetra XXL, whereas in the Italian Stock Exchange block traders freely come to negotiate for large orders.

It appears that special procedures for the execution of block transactions are enforced in markets where block traders are likely to take position in the block transaction. The size and the days taken for a block trade to be “worked” may induce Exchanges to provide for this built-in design feature, beyond the definition of block thresholds, for safe and good conclusion of blocks of considerable size.

1.5.2 Block prices excluded from price discovery

Efforts are being made on the part of European exchanges to exclude the block price from the price discovery mechanism of the trading system. This objective is in part pursued by forcing the block price to interact with the price of the regulated market. In exchanges where no interaction is enforced, Exchanges claim that block prices are not considered in the computation of market indexes, although there is undoubtedly an implicit price impact induced by these large trades.

The issue about whether and to which extent block prices contribute to price discovery is a matter of concern because of the size of these orders and the motivation which may drive block transactions.

If block trades are liquidity-motivated, they cause only a temporary price impact on market prices that then revert to their level prior to the block trade. Conversely, if block trades are information-motivated, market prices are alterated and the resulting prices may not be “true” prices. Therefore many exchanges demand some price interaction and other bland requirements related to transparency. Exchanges that force no “interaction obligation” somehow rely on the role of block traders - acting as dealers or/and brokers - as arbitrageurs to reduce or eliminate pricing anomalies.

1.5.3 Transparency

Transparency refers to the ability of market participants to observe the information in the trading process and covers three aspects of markets - anonymity of counterparties, pre-trade and post-trade publication. The issue concerning transparency is controversial because too much transparency may jeopardize the willingness of traders to offer liquidity, especially in the case of large trades. In effect, institutions concern that their orders may be front-run once counterparts find that a broker who is known to have links with institutions is in the market. Block traders taking position in a block transaction show the same fear as when they have to unwind their position in the market. Conversely, the widespread diffusion of information about the trading process is crucial for the price discovery process.

At European level, efforts have been made to set up minimum common transparency regulatory requirements. The result has been the Investment Service Directive.[13] However, the different market structures in London and in continental European exchanges, and the contrasting national interests as well, lead to the failure of this top-level attempt. Consequently, the combination between transparency and liquidity is ultimately left to the decision of national exchanges.

Anonymity

Anonymity refers to information about the identity of traders submitting orders. In intermediated block markets the counterpart is known to the block intermediary. In electronic block trading systems traders submitting block orders are identified through a code that other upstairs participants can observe. Post-trade anonimity is however maintained.

Pre-trade transparency

Pre-trade transparency concerns the availability of information about the order flow impending in the market and the prices at which incoming orders are likely to be executed. In exchanges with no formal linkage between upstairs and downstairs markets, the upstairs market remains opaque during pre-trade period. In exchanges where interaction rules are enforced, what is displayed at most over the trading

[13]See Steil (1996) for a discussion of the European Investment Services Directive and its effects.

phase is the downstairs reference price at which block trades are crossed. On Xetra XXL, pre-trade transparency is increased by displaying to market participants "tradable" orders and information of existing block trades and the change of trading phase.

Post-trade transparency

Post-trade transparency refers to the availability of data about the last executed trades, and depends on the publication rules of the exchange. There are converging post-trade transparency rules across European exchanges as for tight reporting deadlines, the reporting of all trade details to exchange officials and the release of some trade details to the market (instrument identification, date and time of execution, price and quantity traded in the instrument). The post-trade information however differs in the time of publication to the market.

The publication of large trades is problematic. Actually it jeopardizes the ability of a market maker involved in the block trade to unwind his position in good conditions. Thus quick publication can ultimately result in bad prices for block trades. However, large trades are informative. For prices in the central limit order market to reflect the information contained in these trades, a quick publication of the price and the size of the block trade is necessary. Timely publication is also necessary to prevent counterparties in a block trade from trading on their superior information. This can ultimately impair the liquidity of the central limit order book, by increasing the adverse selection risk faced by limit order traders. Given these costs and benefits of quick publication of large trades, exchanges allow traders to delay publication of the large trades in which they are involved. The conditions under which this delay can occur and its duration vary across exchanges, however. The delay allowed varies from hours to even several days later. Delays are most likely in markets where dealers take position to facilitate investor business: on the London Stock Exchange, for instance, publication of large trades occurs five days following the execution of the transaction or when the block trade has been 90% offset.

1.5.4 Intermediated vs nonintermediated block trading

The SWX and the FWB are the first European exchanges to introduce an electronic trading platform for the handling of large transactions. Nonintermediated electronic auction markets yield trading cost savings with respect to human intermediation. Besides the elimination of broker commissions, electronic trading of large trades ensures immediate execution and considerable reduction of execution costs and risks intrinsec in a broker/dealer-intermediated negotiation (e.g. costs due to information leakage risk).

Currently, block trading is actually distributed among different execution mechanisms. The typical way is telephone trading consisting of direct bilateral trading or brokered trading via telephone. Another venue is the exchange trading through specific non automated trading systems such as upstairs markets. The rapid development of technology also enables block trades to be executed through separated platforms such as POSIT, E-crossnet.

A common feature of the traditional block trading mechanisms is the search process of counterparts. The major risk of the search process is a likely information leakage as when a block is being "shopped" around the market and potential counterparties may learn of it so that the block is priced worse than there is no information leakage. In case of a large amount being traded, an institution wanting to trade even anonymously, will move prices adversely merely in revealing its interest. Knowledge of this interest in the market leads participants to infer that the current market price does not accurately reflect demand. Bids and offers will thus adjust accordingly even without any transaction taking place, thereby precluding the trader from filling only part of the order at the price that prevailed before the block order was revealed. The automation of block trading may significantly reduce implicit trading costs.

Overall, the trend is evolving towards increasing disintermediation of block trading. Some institutions have direct access to the exchange screen for the execution of their orders. It will likely be that human intermediation of block trades will not disappear completely, however. The implication is rather that intermediation that is built into trading structures by design, rather than being chosen by the investor, is unlikely to withstand increasing contestability in the market for trading systems.

1.5.5 Enforcement of interaction rules

Most exchanges worldwide enforce some interaction between upstairs and downstairs markets. Interaction is forced either in price and/or quantity terms: part of a block order must be executed in the central market and/or the prices of off-exchange trades are constrained by central market prices. On the NYSE, for instance, upstairs trades must typically be completed at prices at or within the downstairs Best Bid-Offer (BBO) quotes, and downstairs participants are allowed to take a portion of the block. Similarly, on the Toronto Stock Exchange, upstairs trades need to be executed at or within the BBO quotes in the downstairs market at the time the order is received. On Xetra XXL block prices are crossed at the Xetra midpoint quote. In any case, block prices are allowed to fluctuate within a 10% range at most with respect to the reference price.

The variety of interaction rules across European exchanges calls for some considerations. Interaction obbligation differs in restrictiveness in European exchanges in which it is forced. Euronext markets and in lesser extent the Madrid exchange allow for a cross-sectional variation of the rule depending on the order size and liquidity of the security with consistent effects on execution costs. In contrast, some other exchanges simply require the block price to interact with the downstairs market price regardless of market and individual securities characteristics.

Another consideration arises from the observation that no price links are forced on the Italian and the London stock exchanges. It is apparent that regulators on these exchanges rely on upstairs traders to provide some linkage between downstairs and upstairs markets. Block broker-dealers are somehow informally designated to provide this interaction simply through the best execution they practice in their trading business.

The enforcement of interaction rules is commonly presented as an issue of fairness to order book users as to prevent trade-throughs and upstairs trades free-riding on price discovery. The real effects of such an interaction obligation are not definite, though. One effect is to reduce pricing differential between upstairs and downstairs markets. Booth et al. (2002) find that pricing difference between upstairs and downstairs market on the NYSE is smaller than that on the Helsinki Stock Exchange. The difference in the mean total price effects between upstairs and downstairs trades in the US is no more than two basis points (Madhavan and Cheng, 1997), while this difference increases to roughly 30 basis points on the HSE. The smaller price differential on the NYSE may be due to an NYSE regulation which requires that an upstairs trade has to be exposed to the public in the downstairs market, as opposed to Finland's "best price" rule which only requires brokers make an upstairs trade at a price that is the best price for the customer.[14]

However, restrictive crossing rules may give rise to strategical behavior of block traders at the expense of downstairs traders. Biais et al. (1995) find that block traders on the Paris Bourse respond to exchange's crossing constraints by submitting market orders to clear out limit orders and widen the downstairs spread, so that they can then cross upstairs trades at desired prices. The larger spread at the time of the block trade is even more significant for firms for which block trade prices must obey the crossing constraints than for firms for which blocks are allowed to cross outside the quotes (Besseminder and Venkataraman, 2002). It results that more flexible crossing rules may reduce incentives to manipulate downstairs spreads.

The most notable effect induced by price enforcement is the regulatory arbitrage between exchanges. Paris Bourse interaction rules, created in 1989 after members were permitted to trade for their own account, were significantly relaxed in 1994 owing to the effect of regulatory arbitrage in favor of London. Block traders in Paris routinely executed their block trades in London to avoid having to expand capital or leak information by obeying the Bourse's interaction rules. Even under the current Paris regime, block trades are still often executed in London via screens in Paris to avoid the market impact risk that a dealer might take on in trading within the Paris spread limits.[15]

[14] The larger average price impacts found by Booth et al (2002) may also depend on the relative thinness of their sample.

[15] see Davis and Steil (2001) and Friederich and Payne (2002).

1.6 Conclusions and discussions

The increasing pressure exerted by institutional investors to cut trading costs and the deriving demand for *ad hoc* trading facilities induce European exchanges to compete with each other to improve and implement innovations in the set of trading rules governing institutional trades. There are converging market design features across the largest European exchanges with regard to the handling of block trades in a separate trading arrangement and some transparency requirements. Institutional design features differ more markedly across European exchanges, however. Design features differ in the enforcement of interaction rules, the level of post-trade transparency, and also in the order routing systems of upstairs markets. It remains an open question whether or not regulators should introduce designated intermediaries with particular privileges into exchanges with no forced price links. In fact, broker-dealers already provide some price interaction through best execution.

It is likely that the institutional fragmentation which arises *also* accounts for the different growth of institutional trading across European stock exchanges. The need for immediacy leads institutional investors to have their orders executed through dealers who can provide immediate execution and protection against execution risk, since institutions need to close an arbitrage or to carry out program trading. However, institutions are increasingly aware that immediacy is costly. Immediacy is no longer the main concern of institutional traders if they can obtain lower trading costs (Schwartz and Steil, 1996).

Trading mechanisms for block trading differ across European exchanges because in the view of national Exchange regulators, block trades do not properly form a market; by their very nature, block trades are not standardized and occur less frequently than the normal market order flow, and for this reason seem not to need regulating. However, what is different is the view across European exchanges about the degree of the non-regulation of block trading.

In the perspective of European financial integration, this raises the question: should there be a common regulatory framework at the European top-level, and if so, what scope should it have? More particularly, are common market transparency rules called for? It results from surveys that European institutional investors wished to leave the determination of transparency rules to individual stock exchanges themselves. This should be accounted for while the European Investment Service Directive is being revised.

As institutional investors across Europe are steadly growing in size and in consistency over the normal market flow, the debate over the *ad hoc* market design for institutional trading is in its early stages. So far to our knowledge there have been no empirical works focusing on cross-border performance of the only upstairs markets. More specifically, the way the regulatory arbitrage takes place across European equity markets deserves deeper investigation.

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	$ billion	Percent of total
United Kingdom	4132	40
Switzerland	1997	19
Germany	1456	14
France	938	9
Netherlands	936	9
Italy	306	3
Sweden	257	2
Spain	154	1
Belgium	82	1
Ireland	38	0.4

Table 1.1: European Money Management Centers

This table reports the main European Money Management Centers ranked by the total amount and the percentage of assets managed. Source: Davis and Steil (2001)

	2001			2003		
Exchange	Trading days	Electronic Order Book Transactions	Negotiated Deals	Trading days	Electronic Order Book Transactions	Negotiated Deals
London Stock Exchange	253	1047313.0	4027676.0	189	762214.1	1552026.0
Euronext*	254	1656092.0	613133.0	191	1021506.0	228721.0
Deutsche Börse	255	959837.4	650040.4	191	612077.3	224474.4
Italian Exchange	252	658041.3	51904.4	190	509494.5	34259.8
Spanish Exchanges (BME)**	254	441996.5	166320.3	190	362069.0	230573.7
Swiss Exchange	248	250579.3	79501.7	188	23269.3	6229.9

Table 1.2: Value of equity trading in the major European financial markets.

This table displays the value of equity trading in the LSE, Euronext markets, German markets, Italian Exchange, Spanish Exchange and Swiss Exchange. Data include all market segments, millions Euro (single counted).

Note: The data for 2003 are up to end September. *Euronext markets statistics in 2001 include the Paris Bourse SBF, the Exchanges of Amsterdam and Bruxelles figures and in 2003 also Lisboa Exchange figures. **The data for the Spanish markets in 2001 include only Madrid Exchange.

Source: FESE.

	2001			2003		
Exchange	Trading days	Electronic Order Book Transactions	Negotiated Deals	Trading days	Electronic Order Book Transactions	Negotiated Deals
London Stock Exchange	19	65213.3	67827.6	22	98 605.4	94 984.8
Euronext*	18	102295.0	42651.0	22	133914.0	25704.0
Deutsche Börse	17	56783.0	25817.0	22	81006.0	23648.0
Italian Exchange	17	34171.2	1357.4	22	50889.5	2537.1
Spanish Exchanges (BME)**	17	37541.6	29738.4	22	42686.5	24380.3
Swiss Exchange	17	2631.2	1261.4	22	2303.2	855.7

Table 1.3: Domestic Equity Turnover.

This table reports the figures for domestic equity turnover in the six major European financial markets. Data include all market segments, Euro millions (single counted).

Note: Figures for 2001 are as of end December, figures for 2003 are as of end September. *Euronext markets statistics in 2001 include the Paris Bourse SBF, the Exchanges of Amsterdam and Bruxelles figures and in 2003 also Lisboa Exchange figures. **The figures for the Spanish Exchanges in 2001 include only Madrid Exchange.

Source: FESE.

	2001			2003		
Exchange	Trading days	Electronic Order Book Transactions	Negotiated Deals	Trading days	Electronic Order Book Transactions	Negotiated Deals
London Stock Exchange	19	1453.0	177112.9	22	2550.1	123033.2
Euronext*	18	851.0	122.0	22	889.0	233.0
Deutsche Börse	17	2044.0	6779.0	22	2829.0	7068.3
Italian Exchange	17	3468.4	128.5	22	13832.5	52.4
Spanish Exchanges (BME)**	17	1977.9	0.0	22	342.5	0.0
Swiss Exchange	17	667.7	59.6	22	836.8	64.6

Table 1.4: Foreign equity turnover

This table displays the figures for foreign equity turnover in the six major European financial markets. Data include all market segments, Euro millions (single counted).

Note: Figures for 2001 are as of end December, figures for 2003 are as of end September. *Euronext markets statistics include the Paris Bourse SBF, the Exchanges of Amsterdam and Bruxelles figures and in 2003 also Lisboa Exchange figures. **The data for the Spanish Exchanges in 2001 include only Madrid Exchange.

Source: FESE.

Year	Location	Trading days	Value of Domestic Shares		Value of Foreign Shares	
			Electronic Order Book	Reported Deals	Electronic Order Book	Reported Deals
1999	Amsterdam	22	34 047.0	19 318.0	78.8	373.7
	Bruxelles	22	3 499.3	96.6	356.2	11.6
	Paris	22	67 676.5	n/a	920.8	n/a
	Lisbon and Oporto	19	4 597.3	n/a	n/a	n/a
2000	Amsterdam	19	41 057.6	29 275.3	10.4	77.3
	Bruxelles	18	3 722.4	94.8	251.9	7.3
	Paris	19	89 463.8	5 675.1	1 041.1	13.6
	Libon and Oporto	17	4 581.2	n/a	5.0	n/a
2001	Amsterdam	18	33 865.5	15 506.2	14.8	5.2
	Bruxelles	18	3 018.1	16.2	214.6	59.3
	Paris	18	65410.9	12 055.5	621.5	28.8
	Libon and Oporto	17	2 061.2	n/a	2.5	n/a

Table 1.5: Euronext markets (Cash segment).

This table displays the value of domestic and foreign share value of the electronic order book and reported deals in millions Euro from December 1999 to December 2001.

Source: Paris Bourse SBF. We thank Charles Hoppman at the Paris Bourse SBF for providing us with these data.

	Order book trading		Block trades	
	Trades	Countervalue	Trades	Countervalue
	Number	ML Euro	Number	ML Euro
1995	4 867 774	72 721.3	1 062	5 396.0
1996	5 494 904	81 129.1	1 220	3 168.3
1997	11 880 773	175 370.1	1 539	7 271.6
1998	24 884 935	424 852.8	3 126	18 775.6
1999	28 236 736	502 990.1	3 128	28 370.1
2000	50 687 351	838 491.7	4 796	46 544.3
2001	36 740 354	637 074.9	4 583	45 492.6
2002	37 042 552	622 897.8	3 804	28 904.3

Table 1.6: The Italian Exchange: upstairs and downstairs trades. Equity segment. This table displays the figures of upstairs and downstairs trading in the Italian Exchange from 1995 to 2001. Source: Borsa Italiana, Fatti e cifre 2002.

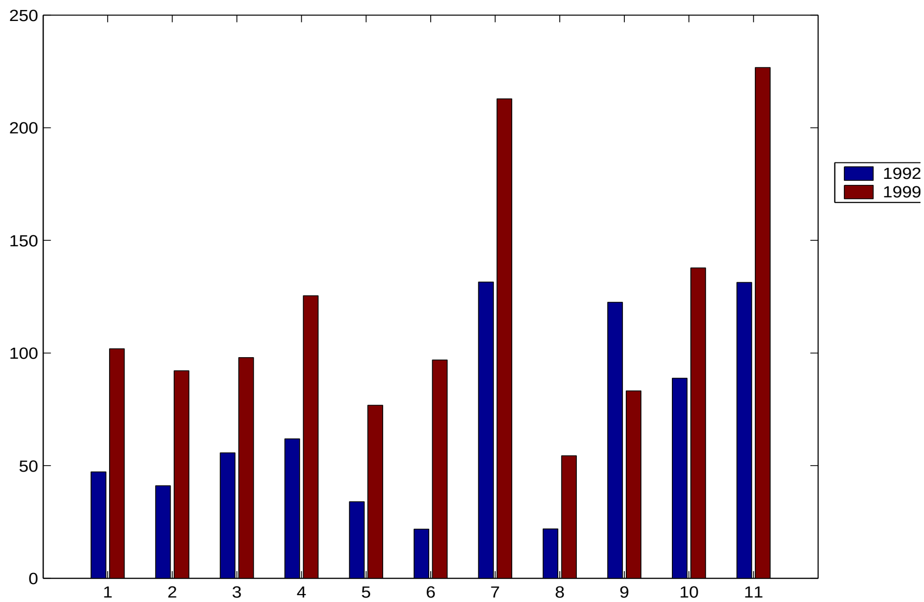

Figure 1.1: Financial assets of institutional investors as percent of GDP

This figure shows the distribution of financial assets of institutional investors as percent of GDP for the following countries: Belgium(1), Finland(2), Denmark(3), France(4), Germany(5), Italy (6), Netherlands(7), Spain(8), Switzerland(9), Sweden(10), UK(11).

Note: Here institutional investors include insurance companies, investment companies, pension funds and other forms of institutional savings. Data for 1999 are provisional. Data for Switzerland in 1999 include only insurance companies.

Source: OECD, Institutional Investor Statistiscal Yearbook 2001.

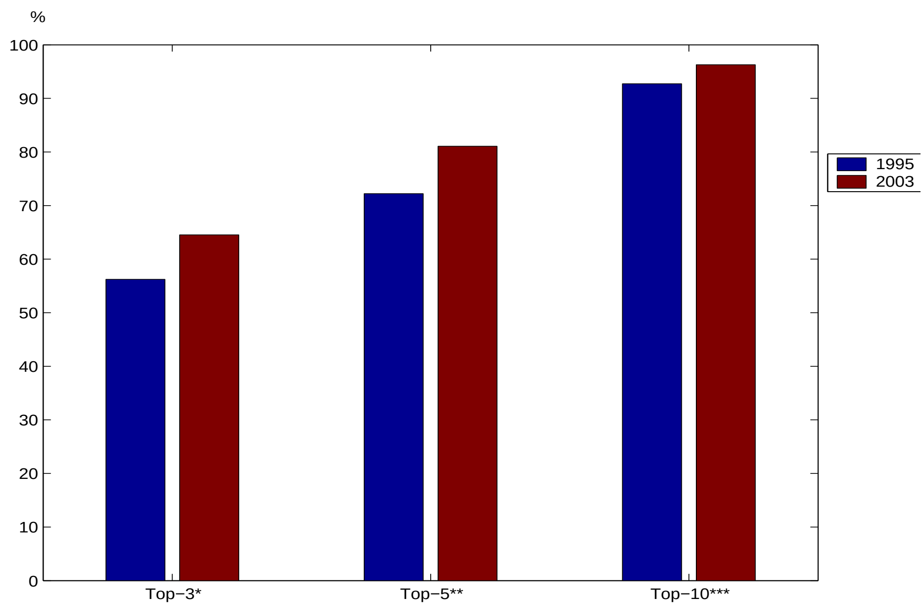

Figure 1.2: Major stock exchanges as a share of EU stock market capitalisation (in millions of USD)

This figure shows the major stock exchanges ranked as fraction of European stock market capitalisation. Note: * 1995: LSE, German Exchanges and Paris Bourse. 2003: LSE, Euronext and Deutsche Börse. ** 1995: LSE, German Exchanges, Paris Bourse, Swiss Exchange and Amsterdam Exchange. 2003: LSE, Euronext, Deutsche Börse, Swiss Exchange and Bolsa de Madrid. *** 1995: LSE, Deutsche Börse, Paris Bourse, Swiss Exchange, Amsterdam Exchange, Borsa Italiana, Stockholmsbörsen, Bolsa de Madrid, Bilbao Stock Exchange and Barcelona Exchange. 2003: LSE, Euronext, Deutsche Börse, Swiss Exchange, Bolsa de Madrid, Italian Exchange, Stockholmsbörsen, Helsinki Exchanges, Copenhagen Stock Exchange and Athens Stock Exchange.
Source: World Federation of Exchanges.

Appendix

A Table 1 - Price and publication of large-block trades

	Publication delay for Block Trades	Block Price
NSC	Order size $<$ 5 NBS i) 2 hours if broker acts as counterparty ii) Immediate if broker acts as agent Order size $>$ 5 NBS i) Next morning if broker acts as countp ii) Immediate if broker acts as agent Structural blocks* Immediate or T+2 if member acting as principal has not offset his position	i) No obligation to execute offers posted at better prices in the limit order book ii) Block price must be inside the weighted average spread, that is computed using the best ask and bid prices in the limit order book up to NBS** iii) Structural block prices can be within +/- 10% of the best ask and bid quote
SETS***	Ordinary risk trade: Immediate publication Worked Principal Agreement: End of the trading day or once 90% of the transaction is offset	i) No obligation to execute offers posted at a better price in the limit order book ii) No price link with central limit order book
SWX	30 minutes	i) No obligation to execute offers posted at better prices in the limit order book ii) Rule of Best Execution: same execution prices as those that could be realized in limit order book.

(continues)

A TABLE 1 - Price and publication of large-block trades

XETRA XXL	At the end of the trading day (8.30 pm)	Reference price: the midpoint price in the XETRA at prespecified times	
BME	At the end of the trading day	i) no price restrictions for authorised special operations ii) +/-1% and +/-15% of the midquote for blocks on agreed terms and blocks with parameters, resp.; abt 5% > the closing or weighted average price for communicated special operations	*
Borsa Italiana	i) 60 minutes if blocks traded during the trading session ii) within 9.00 am next day if executed off-trading hours	Wholesale orders can be executed at any price	

The value of a structural block must represent at least 2% of the company's capital or be greater than FF50m for a stock with a market capitalization larger than FF1bn. It must be at least 5% of the company's capital otherwise. ** A larger spread (SuperWAS) is computed for block trades larger than 5NBS on request to SBF. These trades can be executed at prices within +/-5% of best bid and ask prices. *** Different publication rules are used for stocks that trade in SEAQ [see Pagano and Steil (1996)].

Source: Demarchi and Foucault (1999), national stock exchanges sources.

Chapter 2

Price and liquidity effects around large-block trades on the Italian Exchange

2.1 Abstract

This paper investigates the effects of large block transactions on market prices and liquidity of the most liquid stocks traded on the Italian Exchange where no interaction is enforced and a 60-minute disclosure time is allowed. Our results indicate that at intraday level there is significant evidence of information leakage effect for block sales but not for block purchases. Block purchases induce stronger post-trade effects than block sales. Consistently with prior work we find that block sales appear to be driven by short-term liquidity effects but, by contrast, we find that temporary effects are strong for block purchases. We also document that spreads narrow and depths widen before and after block transactions. This result seems to suggest that block transactions induce an increase rather than a decrease in market liquidity. The effect on the downstairs market is therefore not harmful. Our empirical evidence shows also that large block order flow has a small and weak significant impact on individual stocks' returns. However block order flow leads to no comovements across stocks.

2.2 Introduction

This paper investigates the effects of large block transactions on market price and liquidity of the most liquid Italian stocks. On the Italian Exchange block trades are negotiated off-market with no interaction rules and a 60-minute disclosure time.

The market's reaction to large stock transactions has been the focus of a number of empirical investigations. Scholes (1972), and Mikkelson and Partch (1985) examine the effect on price of large stock sales of secondary distributions; Kraus and Stoll (1972a, 1972b), Dann, Mayers and Raab (1977), Holthausen, Leftwich and Mayers (1987), Chan and Lakonischok (1993, 1995), and Keim and Madhavan (1996) among others, investigate the price effects in case of block trades. The main finding from these studies is that prices significantly drop (increase) following large sales (purchases). However, prices revert after sells but remain high after buys, creating a permanent price impact asymmetry that is viewed as a puzzling empirical result. An explanation typically proposed for the finding that permanent price impacts are stronger for block purchases is that, whereas institutional investors have many reasons to liquidate a stock from their portfolio, the choice of one specific stock to buy is likely to convey private information on that stock (Scholes, 1972; Chan and Lakonishok, 1993).

Theoretical models of market microstructure also point to the potential information content of block transactions to explain movements in quotations and changes in liquidity. Since the objective of informed traders is to maximize their expected profits, informed traders are motivated to trade large sizes in order to gain from their private information. Consequently, trade size induces an adverse selection problem, which results in a reduction of market liquidity (Easley and O'Hara, 1987). Changes in liquidity may also arise from inventory considerations of upstairs traders who take position in the block transaction, or because of portfolio rebalancing strategies of institutional investors.

In this work we examine the impact of block trades on the prices and liquidity for the most liquid stocks on the Italian Exchange. The Italian Exchange is interesting for this analysis because unlike most exchanges worldwide, there is no formal linkage between the upstairs and the downstairs markets. In addition, exchange rules allow a 60-minute delay for the publication of block transactions to the market. In an earlier work on the Italian stock market, Gottardo and Murgia (2000) study the price effects of large block-trades using transaction data on a daily basis over a 5-year sample period. Employing an event study analysis, they find that large block-trades on the Italian Exchange incur high liquidity costs. We extend and complement the work by Gottardo and Murgia (2000) by examining the impact on both market prices and liquidity induced by block transactions in the following directions. First, we study the price and liquidity impacts around the block trade execution time. Our choice of the use of intraday data permits examination of the within-day pattern of common stock price adjustments to potential new information associated with the arrival of block trades on the market. In particular, our focus on the 30-minute time framework around block trade execution time may help to capture any price movement and liquidity shift while the block trade is shopped and after the block trade has been executed. Additionally, the use of order-level data allows for a more efficient estimation of price impacts by avoiding the well-known bid-ask bounce effect that affects studies based on transactional data. Last, our approach is essentially nonparametric, which allows insights not available from a regression specification. Thus our approach avoids particular assumptions about distributional forms or asset pricing models, which would be very difficult to estimate on an intraday basis.

A recent work by Friederich and Payne (2002) studies the market liquidity dynamics on the London Stock Exchange, where, as on the Italian Exchange, no formal linkage is enforced between the central limit order book and the off-book trading venue constituted by a network of broker-dealers. In the view of these authors, the network of broker-dealers forms an upstairs market in that trading takes place privately rather than on a public electronic limit order book. Friederich and Payne find that there exists a natural degree of interaction between these two trading venues. Broker-dealers provide liquidity to trades that cannot be executed in the downstairs market because of the poor market conditions on the limit order book. Our work differs from Friederich and Payne's work in several respects. Whereas Friederich and Payne claim that dealers play a stabilizing role in a trading venue without formal regulatory commitment to do so, we specifically point to a market where the role of upstairs traders is as pure block-brokers. In addition, while Friederich and Payne also consider very large trades in general, here we focus directly on trades that by their nature must be executed off the normal trading session in the central market, namely block transactions. Again, off- and on-book trading on the London Stock Exchange are two alternative trading methods used by investors. Investors can choose to trade through one of the two methods, or, typically, they can use both methods simultaneously. However, this is not the case for the Italian Exchange, since in compliance with Exchange Regulations, all trades are consolidated in the central market, and off-book trading must be viewed as an exception to the principle of consolidation.

We finally address the question whether and to what extent block trading activity gives rise to common factors in liquidity, i.e interdependence in trading costs and trading activity across stocks. Recent research (e.g. Chordia et al. (2001), Hasbrouck and Seppi (2002), Harford and Kaul (2002)) points to the existence of strong covariation in liquidity and trading activity across stocks, patterns which are likely to generate cross-stock commonality. One implication of this finding is that portfolio diversification strategies may not be effective, in that common effects in trading activity affect the variance of diversified portfolios. In this paper we specifically focus on whether block trades give rise to common effects across stocks. This analyisis would provide insights on the extent to which the upstairs and the central market interact and the way these two trading venues interact effectively in absence of any formal linkage between these two trading venues.

The remainder of this paper is organized as follows. Section 2.3 is devoted to an overview of the literature. In section 2.4 we provide a description of the institutional settings and the dataset. Next, we focus on the analysis of intraday block trading activity on the downstairs market by analysing the price and liquidity impacts. Section 2.6 provides empirical evidence on commonality in liquidity and order flow. Section 2.7 concludes.

2.3 Literature overview

We can identify three basic strands of literature on block trading that are relevant to our work: price effects associated with large block trades, liquidity effects induced by large and/or block trades over the earning announcements, and the trading mechanisms for upstairs trading.

The empirical literature on block trading documents two linked price effects associated with block trades: *temporary* price effects and *permanent* price effects. There are three main hypotheses competing to explain these effects: short-run liquidity costs, imperfect substitution or inelastic demand and offer curves, and information effects.[1]

Short-run liquidity costs resulting in temporary price changes arise because it is difficult and costly to identify immediately the potential counterparts to the large block trade. As emphasized by Kraus and Stoll (1972), market prices may deviate from their equilibrium value because intermediaries must be compensated for their service. In most stock exchanges worldwide, block transactions are typically arranged through block traders (dealers or brokers) off the regulated market. Efforts to attract buyers or sellers translate into price concessions. The seller of a large block trade gives the block trader a price concession as compensation for inventory and search costs. Similarly, a purchaser of a block trade pays a premium if it is costly to identify sufficient potential sellers of smaller portions of stock at the current market price. Under the short-run liquidity costs hypothesis, market prices subsequent to the block trade quickly revert to the previous price equilibrium.

Prices also change around large trades if there are no perfect substitutes for a particular stock. The imperfect substitutes hypothesis, also known as the distribution effect hypothesis, assumes that securities are not close substitutes for each other. Hence, a seller faces a downward-sloping demand curve and a buyer an upward-sloping supply curve. Therefore, the seller in a block trade has to offer a discount to induce buyers to purchase and hold additional shares. Similarly, a premium has to be offered by the buyer in a block trade. Under this hypothesis, equilibrium prices change when demand curves shift to eliminate excess demand. Price reversals are not expected or occur more slowly compared with the prediction of the short-run liquidity costs hypothesis. The effects of price changes are permanent because the new equilibrium price reflects a new equilibrium distribution of security holders (Kraus and Stoll, 1972a).

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[1]There is an extensive literature testing the various price response hypotheses. Most of them study price effects surrounding stock index redefinitions. When an index is redefined investors who follow it must reduce their holdings of securities that have been downweighted in the index and buy those whose weighting has increased. Under the efficient market view, these demand shifts should not affect prices, as they carry no information about fundamental value. Harris and Gurel (1986), Schleifer (1986), Wurgler and Zhuravskaya (2002), among others, provide empirical support for the existence of price pressure and downward demand slope effects for the Standard and Poor's list of 500 stocks. Also Kaul, Mehrotra and Morck (2000) reach the same conclusion for the Toronto Index.

Permanent price changes associated with block trades are also expected if the trades convey private information. In an efficient market where there are many small buyers and sellers and there are no transaction costs, prices of securities change on the arrival of new information and the new price level for the stock is maintained until additional information induces another price change. Transactions have no discernible effects on market prices since many investors compete for information and there are many buyers and sellers willing to buy or sell small amounts of stock at a price very close to the prevailing one. However, this is not the case for the sale or purchase of a large block of stock. Scholes (1972) argues that large block trades are likely to contain more information than small quantities of stock because some groups are more likely to possess private information. Informed sellers believe that the stock is overpriced, and informed buyers believe that the stock is underpriced. Hence the size of a block transaction may also proxy for the amount of information the trader has about a firm.

Saar (2001) provides an alternative explanation to the observed permanent price effect asymmetry. He suggests that the asymmetric price impact pattern may arise from the information set about stocks and the set of constraints on the allowable trading strategies institutions employ. More specifically, institutional investors hold relatively diversified portfolios ("diversification constraint"), and cannot short sell ("short-selling constraint"). In this setting, the way portfolio managers optimally use information when they have the ability to search for private information about multiple stocks is crucial in creating the observed difference between the information content of buys and sells. Saar demonstrates that block trades during periods of poor price performance or little price appreciation should exhibit stronger positive asymmetry. Consider a stock i. Because the run of price improvements stock i experiences is short, the probability that stock i is included in the portfolio of any institutional investors is low. Hence, good information about the stock may prompt many institutions to buy it, resulting in a high probability of an informed buy. Since most institutions do not own the stock, they cannot sell it on a bad-information event day, so the probability of an informed sell is low. This creates a positive permanent price impact asymmetry. Conversely, block trades that follow a good performance should exhibit less asymmetry or even negative asymmetry. This occurs because, as stock i's price rises, more institutions buy that stock, and the probability that stock i is in an institutional portfolio is high. However, because of the diversification constraint (an institution that holds stock i will not buy more blocks of that stock), the probability of an informed buy decreases. Yet since many institutions own the stock, the short-sale constraint is not binding and bad information will result in informed sells. Hence the probability of an informed sells increases. This effect may induce even negative permanent price asymmetry if the stock price has been going up for a sufficiently long period. In Saar's model, the trading intensity of institutional investors, the frequency of information events concerning the stock and the stock's volatility also affect the asymmetry phenomenon.

The effect on market liquidity of large block transactions has received very little explicit attention so far. Most papers incorporate the analysis of liquidity effects induced by large trades[2] but not block transactions, or they examine the effects on market liquidity over a particular event environment. The first group of studies includes the works by Biais et al. (1995) for the Paris Bourse and Moulton (1998) for the NYSE. Biais et al. (1995) find that brokers systematically widen the quotes in the downstairs market at the same time of the execution of a block trade in the upstairs market. This allows the block trade to be executed within the limits set by the Paris Bourse. Nevertheless, quotes return to their pre-large-trade-level quite quickly (two minutes). Moulton (1998) arbitrarily defines a large trade as 5,000 shares or more in order to account also for informed traders' trading strategies of camouflaging themselves by trading smaller large trades. His findings indicate that large trades have a disruptive effect on the continuation of subsequent trade in that quoted liquidity decreases after large trades. In conclusion, both studies show that there is a systematic drop in quoted liquidity after large trades, although market liquidity returns to its pre-large trade level quite quickly.

The second group of studies includes the works by Lee, Mucklow and Ready (1993) (henceforth LMR), and Koski and Michaely (2000). LMR provide interesting insights into market liquidity dynamics. They first study the general relation between spreads, depths and volume. Using observations at half-hour frequencies for firms on the New York Stock Exchange, they find that wide spreads are associated to low depths and narrow spreads are accompanied by high depths. This relation holds also after they have controlled for intraday patterns. They also investigate the effect of volume on quoted liquidity. Their findings suggest that quoted liquidity decreases in response to volume shocks. LMR then examine the market reaction to earning announcement and large-volume periods, in particular they focus on liquidity shifts in the period surrounding earnings announcements. Their results indicate that there is a drop of liquidity one day prior and subsequent to the announcement. Most importantly, liquidity decreases dramatically in the half hour containing the announcement. This evidence appears to suggest that the liquidity providers, especially the specialist, can somewhow anticipate the timing of earnings news and react quickly to changes in information asymmetry by adjusting both spreads and depths.

A more thorough investigation into price and liquidity effects is provided by Koski and Michaely (2000). These authors examine price and liquidity impacts of trades of various sizes during a range of periods, which by assumption might show different degrees of asymmetric information. In particular, they analyze trades around dividend announcements, regular periods, ex-dividend day periods, and dividend captures trades. Their results indicate a strong positive relation of price and liquidity effects to information asymmetries (as measured by the information environment of the trade) and trade size. The price impact of trade is the largest in magnitude during announcement periods, it is smaller during regular periods, and even smaller during ex-dividend periods. Liquidity is lower during announcement

[2] In these studies, large trades are defined as trades trades whose size exceeds the depth available on the opposite side of the book at time of the order arrival.

periods than during other periods. Consistently with previous research, they find asymmetric price effects for block purchases and block sales, however block purchases induce significant price effects during all periods, whereas the price impacts for block sales are less dependent on variations in the information asymmetry of the period. Liquidity also decreases immediately after block trades, significantly after block purchases. The findings by Koski and Michaely indicate that the impacts of blocks on market liquidity vary relevantly with the information environment.

A third strand of literature related to this work deals with the economic role of upstairs markets. In Grossman (1992), the discrepancy in the information set is the foremost distinghishing feature between the upstairs and the downstairs markets. This leads to different performances and functions of the two trading venues. Grossman argues that because of their superior information of the market order flow, block facilitators are more able to accommodate "latent liquidity demand". This benefit to customers arises from the search process block traders are involved. While searching for the counterpart, block traders acquire important information about the potential needs of customers which are not expressed in the downstairs market order flow through limit orders. Therefore, upstairs trading appears to fit better the specific needs of customers in relation to the size of the order and to financial instrument traded with respect to downstairs trading. In addition, the upstairs market has a screening role. Since upstairs trading is not anonymous, an institution can develop a reputation with a block trader for being an "informationless" trader. In this view, upstairs markets screen for uninformed traders that are motivated to signal their identity by a binding "no bagging" commitment. Hence, these traders are able to obtain superior upstairs execution (Seppi, 1991).

Recent empirical works focus also on the role of the market design of the market for large block transactions in affecting market price and liquidity. In particular, the way the upstairs and the downstairs markets interact may affect the cost of trading to institutional transactions. Two issues are of great concern to academics and practitioners: the cost of liquidity provision for large block trades on these trading venues, and the potential harmful effects of the diversion of order flow of upstairs markets. The issue of the cost of liquidity provision for large block trades on upstairs markets is addressed for the first time by Madhavan and Cheng (1997). These authors find that block trades routed to the upstairs market in the NYSE incur smaller price impacts than downstairs block trades. Empirical evidence from Smith et al. (2001) for the Toronto Stock Exchange, Besseminder and Venkataraman (2001) for the Paris Bourse, Booth et al. (2002) for the Helsinki Stock Exchange, and Fong et al. (2003) for the Australian Stock Exchange reach the same conclusion. For instance, Booth et al. (2002) and Smith et al. (2001) report, for the respective stock markets, that upstairs trades have a lower permanent price impact than those executed downstairs, which they ascribe to the difference in anonimity between trading venues. Indeed, because they are signaled as noninformative trades, large block trades on the upstairs market incur lower execution costs than those executed in the downstairs market.

A common feature of these studies is that they are conducted on exchanges which enforce some formal linkage between the upstairs and the regular markets. Gottardo and Murgia (2000) examine the price impacts of large block transactions on the Italian Exchange where no formal interaction is provided between the two trading venues. These authors find that block transactions induce significant price impacts and conclude that investors incur high average execution costs in the upstairs market on the Italian Exchange. They suggest that this may be caused by lack of alternative trading mechanisms in the Italian Exchange which are able to absorb large transactions.

As mentioned previously, Friederich and Payne (2002) address the issue of the interaction between a central limit order book and an off-trading venue constituted by broker-dealers who have no formal commitments. The main insight from their analysis is a segmentation of order flow by trade size. The electronic limit order book is an important source of liquidity for all of their stocks, but not for all trade sizes, since dealers tend to execute very large share of both very small and very large trades. They find also that order flow tends to migrate from the book to dealers when market conditions worsen (e.g. increasing volatility, order flow imbalance).[3] One implication of this result is that dealers play an important role in stabilising prices and absorbing order imbalances. Most importantly, they do this on a voluntarily basis, which implies that there is no need for designated intermediaries with formal regulatory commitments.

In conclusion, empirical evidence shown by these works indicates that there is the need for an alternative trading mechanism, under the form of the upstairs market, when handling large block transactions, in that extra liquidity is supplied for those large transactions that whould not take place otherwise. It appears that there is a complementary relation between downstairs and upstairs markets in serving different clienteles with different demands for liquidity. This provides strong support for the Grossman (1992)'s prediction that block traders are able to tap into pools of unexpressed liquidity to supply better upstairs executions relative to the displayed liquidity in the downstairs market and for the Seppi (1991)'s argument that upstairs markets screen among informed and uninformed traders. Empirical findings suggest also that the upstairs market activity does not cannibalize the order flow in the downstairs market, i.e. as a whole, the upstairs market leads to no harmful effects on downstairs liquidity caused by market fragmentation.

2.4 Institutional details and data

2.4.1 Trading on the Italian Exchange

Trading in the upstairs and downstairs markets in the Italian Exchange takes place in two completely separated trading venues. Since 1991 small-medium size orders are consolidated in an electronic public limit order book, whereas transactions whose value is greater than some thresholds are allowed to execute off-exchange. The electronic order book shows trading proposals (Proposte di Negoziazione -

[3]Unfortunately, they do not address the question of price effects of block trades that execute off the limit order book.

PDN - hereafter) entered by Exchange members and displays buy (sell) orders in increasing (decreasing) manner according to the best price rule. Trading on the order book is completely anonymous. On their own computer screens, traders observe the five best levels of the book, the code identifying the operator submitting the order, and the track record of the orders and trades they execute.

The daily trading session consists of a pretrading stage followed by a continuous auction structure. The pretrading stage is a call auction consisting of a pre-opening, a validation and an opening phase.[4] Since May 2001 an evening trading session from 6:00 P.M. to 8:30 P.M. has been supplied and resembles the daily continuous trading (the After Hour Trading). In this trading session three separate market indexes (MIB 30-s, MIBTEL-s and MIDEX-s) are computed at predetermined intervals.

By exchange rules, a transaction can take place off the central market provided that 1) the client has supplied a prior written authorization; this authorization must concern individual transactions and 2) the execution of off-exchange transactions take place at a better price for the customer (best execution principle). Transactions which meet these two conditions may execute off-exchange and take the form of block trades or the so called *fuori mercato* transactions (off-market transactions). Block trades differ from the off-market trades because of mandated minimum block thresholds. These thresholds are updated every six months and are calculated on the basis of the average daily turnover of the previous six months. For the period under examination there were the following block thresholds:

- not less than 150,000 Euro for stocks with an average daily turnover of less 1.5 million Euro;

- not less than 250,000 Euro for stocks with an average daily turnover between 1.5 and 3 million Euro;

- not less than 500,000 Euro for stocks with an average daily turnover between 3 and 10 million Euro;

- 1.5 millions Euro for stocks with an average daily turnover greater than 10 million Euro.

Block trades are typically executed through exchange members via telephone negotiation. Exchange members can act on third basis (brokers) or on principal basis (broker-dealers). In this latter case no broker commission is charged. Gottardo and Murgia (2000) report that, because exchange members rarely commit their capital in positioning block transactions, they always act as pure block brokers. Their reluctance to take position in the block transaction may arise from the high average capital commitment required by exchange rules, although the high volatility of the Italian stock market seems to be the primary motivation. Because of the peculiar ownership structure of Italian listed companies (the ownership of these companies is highly concentrated in a few large shareholders), it is quite common for large shareholders of listed firms to act as security dealers, so that the role of

[4]In the pre-opening phase from 8:00 A.M. to 9:15 A.M., orders can be entered, modified or deleted but no trading occurs. In the second and third phase - from 9:15 to 9:20 A.M. and from 9:20 to 9:30 A.M.,- respectively, traders take no action. The purpose of the pretrading session is to determine the quotation for each security to trade in the continuous auction.

upstairs traders is confined to the only search of the counterpart. While the upstairs market in the Italian Exchange is formally organized as a dealer market, upstairs traders *de facto* act as pure block brokers.

Exchange rules allow for different publication timings of large block trades. For block trades executed during the trading session, member firms must report the Securities Market Authority all block trade details within 90 seconds from the execution. Block trades executed off-exchange are allowed to be reported at the latest by 9:30 A.M. of the next trading day, before the opening of the regular trading session. Whereas the reporting of block trades is immediate and concerns all the details, exchange rules allow for a 60-minute delay for the publication of block trades executed during trading hours or by 9.00 A.M. of next-day opening session for block transactions executed off-trading hours.

2.4.2 Data and summary statistics

The data examined in this study consist of all large block trades and central market transactions of the 30 Milan Stock Exchange Index (the MIB30) component stocks over the month of November 2001. The data set for block trades contains the name of the stock traded, the date and the time of execution, the block price per share net of commissions and the quantity (number of shares) of the block transaction. The data set for the electronic public limit order book consists of transaction and limit order book observations. Transaction data include all time-stamped transaction prices and volume recorded to the nearest second. Limit order book data include time-stamped limit order prices, order quantity, and the number of orders in the same queue up to five queues.

Because not all stocks experienced the execution of block transactions over the sample period, for the purpose of our empirical analiysis we consider only stocks that had one block trade at least and for which both block trades and transaction- and order-level data are available. We also focus on those block trades executed over the continuous auction time (from 9:30 A.M. to 5:30 P.M.) because of the different matching procedures at the opening. Indeed, the opening price comes from a call auction whereas after the opening the market switches to a continous matching procedure. The choice of the continuous auction ensures comparability of empirical results. The final sample is of 24 stocks with 185 block trades.

Our data set does not allow us to know whether a block was purchased or sold. Therefore we follow a procedure similar to that suggested by Lee and Ready (1991) to infer block trade initiation. If the block price at time t is higher (lower) than the transaction price in the central market at time $t-1$, the block trade is buyer- (seller-) initiated. For zero-tick blocks we rely on the midpoint quotation at time $t-1$ from the execution of the block trade.

A matching procedure allows us to infer the trade direction for the downstairs transaction data. A trade at time t is matched against the order recorded at time $t-1$ on the opposite side of the book. We go back by matching orders at time $t-2$ if the trade at time t is not matched with any order at any of the five levels. We control for price and quantity of both the trade and the order to assure this correspondence. However, occasionally there are trades placed immediately after the beginning of the continuous auction for which the trade initiator is unidentified. These trades may be cross orders (orders whose prices are inside the quoted spread), or trades which "walk" the book (trades executed at multiple prices) or impending trades which are then executed according to different trading parameters (such as kill orders).

We apply further filters to eliminate quotes and trades that do not show economic reasons: 1) null bid and/or null ask prices, bid prices larger than ask prices and relative depths are excluded; 2) transactions after the start of the continuous auction but before the first quotation available on the limit order book in that they stem from the pretrading phase.

Table 2.1 displays the summary statistics of the distribution of block trades by block type executed over the regular trading session. Our sample is slightly dominated by buyer-initiated blocks.[5] The average and median quantity (number of shares traded) of block purchases are far larger than the mean and median block volume of block sales. A deeper insight into the intraday distribution of block trades per number of trades executed (Figure 2.1) shows that buy block trades execute more intensively at the end of the trading day whereas most sell block trades execute in the morning. The average volume of buy block trades is also larger than sell block trade volume (see Figure 2.2).

Table 2.2 provides the average and median volume in share and value by trade size for large-block and downstairs trades. The trade size cutoffs in each group are determined on each firm's trade size distribution. The reason for this classification is to define block and trade sizes into small, medium and large trade for each firm relative to the order flow experience for the firm over the sample period. This allows for a comparison of the amount of trade size for upstairs and downstairs trades. From a comparative inspection of the average size for both upstairs and downstairs transactions, it is apparent that the the high average block size may hardly be executed but in very smaller quantities in order to avoid any adverse impacts for the block initiator and users of the downstairs market.

2.5 Intraday price and market liquidity effects

This section is devoted to the analysis of price and liquidity effects associated with large block transactions at intraday level. We first turn to gauge the impact of block trades on market price and then complement this analysis by examining the effects on intraday market liquidity.

[5]This is in contrast with the general finding in the U.S. equity markets that block trades are sold (e.g. Kraus and Stoll (1972)). The 5-year sample of block transactions used by Gottardo and Murgia (2000) for their study is also dominated by buyer-initiated block trades.

2.5.1 Methodology

For the intraday analysis we consider time windows of 30 and 60 minutes around the execution of block trade. We examine price and liquidity effects prior and subsequent to the block trade over these time windows. Since exchange rules allow for 60-minute disclosure delay, the time window we choose would be long enough to capture any price changes and liquidity shifts.

Our data set reports some block trades that are executed at the same time during the day. We consider these block trades as one single large block transaction by aggregating the volume of these block trades. More problematic is the issue of "trailing" blocks over the same day, that is block trades that are executed consecutively in quick succession. It is more likely that these block trades stem from the same block initiator as being *slices* of a larger individual block trade. A methodological difficulty arises from the issue of multiple blocks, namely they lead to overlapping downstairs transaction observations if they are considered as independent. The usual methodology on block trading identifies a set of blocks, establishes the pre- and post-equilibrium prices for each block, and computes the price impact. These articles construct their samples so that the issue of multiple blocks between the pre- and post-equilibrium prices is, to a large extent, either avoided or ignored.[6] Omitting the "trailing" block trades may cause loss of relevant information contained in these block trades. Therefore, we consider these "trailing" block trades as one single block but with different ending points of the time window: considering a 30 minute time interval from the block execution time, we retain all downstairs observations (transactions and orders) occurring 30 minutes prior to the execution of the first block trade and those observations that take place 30 minutes following the execution time of the last block trade of the "trailing" block trades.

An additional issue related to multiple blocks is the definition of the time span separating the execution of one block trade from the preceding one. Since we do not know whether two or more block trade are "trailing" blocks, we can only conjecture about the time they are executed each from the other. For instance, if we consider that a block trade is executed from the previous one over a time span of five minutes, we may erroneously include blocks that are not actually a "trailing" block trade. Hence, we arbitrarily choose a shorter time period of two minutes. This would ensure that we indeed include block trades that are really "trailing". In the end, we are left with 172 block trades.

2.5.2 Empirical results

Price effects

Temporary impacts are price reversals observed after the block has been executed. Following Holthausen et al. (1987) and Besseminder and Venkataraman (2002), we measure this liquidity component of price

[6] In Holthausen et al. (1987), if there is a day with two block trades, the first one will be eliminated and the second one will be used in the analysis.

effects as $TEMP = \ln(P_b) - \ln(P_1)$, where P_b is the block price, P_1 is the measure of the post trade value. Because we do know the exact timing of when the market prices revert to their equilibrium value before the block execution we proxy P_1 using the midpoint of the first quote reported 30 and 60 minutes after the block trade.

Permanent price impacts are the changes from the equilibrium price before the block trade to the equilibrium price afterward. The permanent component can be divided into the information leakage and post-trade components. The former measures the information leakage while the large-block trade is impending. This effect can be measured as $IF = \ln(P_0) - \ln(P_d)$ where P_0 is the pre-trade value of the stock in the downstairs market proxied by the last midquote prior to the block trade and P_d is proxied by the midpoint of the quotation at 30 and 60 minutes prior to the block trade. The need for using more lagged benchmark prices is that this allows to better capture the true price impact. The post-trade impact reflects the price change after the block trade is executed: $PT = \ln(P_1) - \ln(P_0)$. The total execution cost is the sum of the temporary and permanent components: $TT = \ln(P_b) - \ln(P_d)$. All price effects are unadjusted. Our analysis is on the sample of block trades for which for each time interval it is possible to retain downstairs observations prior and subsequent to the block execution.

Table 2.3 shows the median results for the common sample. There is no evidence of any significant permanent component of price impacts associated with large block transactions. Conversely, block transactions induce short-term liquidity costs. We further investigate whether a different price effect behaviour arises when distinguishing the block initiator. Consistent with previous research we document an asymmetric behaviour of price effects of block sales and block purchases. Table 2.4 shows the median results for temporary, permanent and total price impacts for seller-initiated blocks. The sales of large blocks show significant short-run price effects: at any price benchmark the median temporary price effect is significant at 1% level. Block sales induce also significant permanent price effects, although information leakage and post-trade effects yield different behaviours of price impact. There is evidence for significant price movements 60 minutes prior to the execution of block trade with central market prices increasing significantly at 5% level. Half an hour following the block trade execution, central market prices decrease. This post-trade price impact is significant at 10%, however. This price pattern seems to suggest that the central market is able to anticipate the timing of block trades, but before the block trade is executed, this information is uncertain. Once the block trade is executed and the uncertainty associated with the block trade is resolved, the market readjusts the prices downward. Overall, our finding that seller-initiated block trades are significantly driven by temporary effects is consistent with the short-term liquidity cost hypothesis.

The results for buyer-initiated block transactions are reported in Table 2.5. The magnitude of temporary price effects for block purchases is higher than for block sales. In contrast with previous results on US equity markets, we find positive and significant temporary price impacts for buyer-initiated block transactions. This was not typically observed in past studies. Empirical evidence showed that while seller-initiated block trades induce significant temporary price effects, buyer-initiated block trades do not. Chan and Lakonishok (1993) argue that no temporary effects for most buyer-initiated block trades may arise because brokers are reluctant to take short positions to accommodate a block purchase. Gottardo and Murgia (2000), who also find positive and significant temporary price impacts for block purchases, note that given the institutional setting of the Italian market, it is less likely that brokerage firms frequently short stocks just traded in the upstairs market. As a matter of fact, the ownership of most listed Italian companies is concentrated in a few large shareholders, who often act as security dealers.[7] Again, our finding that short-run liquidity costs are associated with block purchases is consistent with the price pressure and liquidity costs hypothesis.

Surprisingly, we find no significant evidence of the information leakage component for block purchases at any price benchmark. However, block purchases induce strong post-trade effects: after the block purchase is executed, market prices increase even over 60 minutes following the block trade execution.

In sum, our analysis of price impacts of block transactions seems to suggest that short term liquidity costs mostly drive the effects on the downstairs prices. Although post-trade effects are significant for block purchases, the magnitude of the effect is small (about 0.1%). Post-trade effects may reflect permanent price effects due to the distributional hypothesis rather than the informational motivation.[8] A comparative analysis of total costs indicates that buyer-initiated block trades incur higher execution costs than seller-initiated block trades.

Liquidity effects

Liquidity is difficult to measure because it is multidimensional. Any analysis of liquidity should consider the price dimension (the spread) and the quantity dimension (the depth) to account for any interdependence between the two. We compute the following liquidity measures of quoted liquidity:

S_k=$(Pask_k - Pbid_k)/[(Pask_k + Pbid_k)/2]$ is computed as the inside spread scaled by the midquote. $Pask_k$ and $Pbid_k$ are the ask and bid price, respectively, for quote record k.

D_k=$Dask_k + Dbid_k$ is the inside depth, where $Dask_k$ and $Dbid_k$ denote the number of shares posted at ask and bid quotes, respectively.

Following Hasbrouck and Seppi (2001), we also include the following liquidity measures:

$QS_k = (Pask_k - Pbid_k)/(\log(Dask_k) + \log(Dbid_k))$ is the quote slope.

$logQS_k = \log(Pask_k/Pbid_k)/(\log(Dask_k) + \log(Dbid_k))$ is the log quote slope.

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[7] Gros-Pietro et. al (2001) provide an exaustive analysis of the structure of Italian companies.

[8] Interestingly, Michaely and Murgia (1995) show that block trades in the Italian stock market may be driven by motivation different from information asymmetry. They find that block trading around the ex-dividend day period is significantly related to differential taxes. Because of the limitations of our data set, we are not able to test for this hypothesis.

The last two liquidity measures may be viewed as summary measures of the quoted liquidity supply curve in that they combine both price and quantity information available at the best ask and best bid quotes. The quote slope is the slope of the quoted liquidity supply curve: the smaller the slope, the more liquid the market.

All the liquidity measures are computed at the beginning and the end of interval t as percentage deviation from their average over non-event (normal) period at the same time interval.[9] The non event period includes trading days excluding the day of the event. Hence:

$$LM^*_{b,t} = 100 * \frac{LM_{b,t} - mean\ LM_{b,t} on\ normal\ days}{mean\ LM_{b,t} on\ normal\ days}. \tag{2.1}$$

A Wilcoxon signed rank test is performed to test that there is no median abnormal effect. We employ the median measure rather than the mean because the median is more robust to the effect of outliers.

We also examine the impact of block trades on liquidity in transaction event time.[10] While our analysis in clock time would allow to control for systematic differences across trading periods of the impact of block trades on liquidity, one advantage of looking at liquidity effects in transaction event time is that this takes into account liquidity differences across single trades. We use a methodology similar to that employed by Koski and Michaely (2000). The excess spreads is computed as

$$\overline{XS}_t = \frac{\sum_{b=1}^{Nblc}[S_{b,t} - BenS_i]}{N_i}, \quad t = -5, \ldots, +5, \tag{2.2}$$

where

$$BenS_i = \frac{\sum_{b=1}^{Nblc}\sum_{t=-20}^{-11} S_{b,t}}{N_i}, \quad i = 1, \ldots, N. \tag{2.3}$$

and

$Nblc$ denotes the total number of block transactions for stock i.

We first construct a benchmark spread series for each block trade b of stock i for quotes -20 through -11 relative to the block trade of interest b. The excess spread is then computed for quotes -5 through +5 relative to block trade b. A similar methodology is followed to compute the quantity dimension of liquidity, the depth quoted at the best bid and best ask sides:

$$\overline{XD}_t = \frac{\sum_{b=1}^{Nblc}[InsD_{b,t} - BenD_i]}{N_i}, \quad t = -5, \ldots, +5, \tag{2.4}$$

[9] We consider the end- (beginning-) of-interval quotation rather than the average over the interval because it is a cleaner test of market response.

[10] See e.g. Holthausen et al. (1990), and Koski and Michaely (2000).

where

$$BenD_i = \frac{\sum_{b=1}^{Nblc} \sum_{t=-20}^{-11} InsD_{b,t}}{N_i}, \quad i = 1, \ldots, N. \tag{2.5}$$

A T-statistic is performed under the null hypothesis that the mean excess spread (depth) equals to zero.

Table 2.6 reports the median results for the liquidity measures computed prior and subsequent to individual block trade execution. Our results show that all liquidity measures have negative sign. The relative spread narrows within 60 minutes before the block trade execution and shows a similar pattern also in the 60 minutes following the block trade execution. The effect of block trades on liquidity measured as depth is also negative. However, it is not statistically significant at any time interval except in the 30 minutes prior to the block execution. The quote slope and the log quote slope also seem to decrease significantly. We interpret these results as block trades inducing an increase rather than a decrease in liquidity.

We also report results for block sales and block purchases in Table 2.7 and Table 2.8, respectively. We find no significant evidence of asymmetric liquidity effects depending on the block initiator. Similarly to our findings for the common sample, all liquidity measures show negative sign both for block sales and block purchases. In contrast with the evidence on price impacts, we find no differential liquidity effects between block purchases and block sales: both induce significant increase in liquidity prior and subsequent to block trade execution. Only liquidity measured by inside depth shows no significant shifts at any benchmark.

From the theoretical point of view, there are two alternative predictions as to the effects on market liquidity after a large block trade. The arrival of a block trade on the market is often viewed as a signal that there is a greater probability that private information exists. Consequently, it increases the adverse selection problem and leads to a decrease of market liquidity (larger spread and lower depth) after a block trade. Alternatively, it is possible that block trades potentially resolve rather than increase the degree of information asymmetry and consequently lead to greater liquidity. This implies that if block trades are informative - and they are very informative - block trades reveal much information and reduce asymmetric information. Because of the particular Italian market setting, block trades in the Italian Exchange are likely to convey information about changes in the corporate governance of the company whose stock is object of the block trade.

Table 2.9 reports the results of the analysis in transaction time for the excess spreads. These results overall support our main finding that block trades lead to greater liquidity. We can observe two notable patterns. First, although the excess spread is significantly different at quotes both prior and after the block trade, the magnitude of the impact of block trades exhibits no substantial changes at any quotes. A second pattern is that no differential effects arises when we distinguish between block purchases and block sales.

Liquidity measured by inside depth shows a similar pattern (Table 2.10). In contrast to the results on depths from the analysis in clock time, here we find that block trades induce significant effects on depths. Again, these results show that there are significant impacts on depths prior and after block trade, but there is no difference in the liquidity pattern between block purchases and block sales.

2.6 Common effects in returns and block trading activity

Recent empirical findings regarding market microstructure document the existence of comovements in liquidity and order flows across stocks. The results are not definitive, however. In particular there is a divergence depending on differences in frequency of aggregation and trading activity variables. Chordia et al. (2000) explore cross-sectional interactions in liquidity measures using daily quote data, and assign a special role to the market portfolio. They document strong common effects in changes of daily liquidity measures. Halka and Huberman (1999) estimate time series models for quotes and depths for market capitalization weighted portfolios. They find evidence of commonality in liquidity in that the estimated model residuals are correlated across portfolios. Conversely, Hasbrouck and Seppi (2001), and Harford and Kaul (2002) find strong cross-sectional effects in order flow and returns at intraday level, but no evidence supporting significant common factors in liquidity. Hasbrouck and Seppi (2001) use principal components to detect co-movements in intraday order flows, returns and trading costs across the 30 Dow stocks, and canonical correlation to establish that the common factors are related. Harford and Kaul (2002) extend the work by Hasbrouck and Seppi (2001) by accounting for different sources of common effects on samples of index and non-index stocks. They find that indexing is the primary source of common effects in order flow and returns for index stocks, followed by industry and broad market factors. Conversely, common effects for non-index stocks appear to be driven by industry and broader market order flow and industry returns. They conclude that common order flow effects are not therefore pervasive, in that non-index stocks show little common effects in order flow.

The purpose of this section is to investigate whether upstairs block trading activity leads to common effects in returns across stocks. Because no formal linkage is enforced between the upstairs and downstairs markets on the Italian Exchange, examining whether upstairs trading leads to interdependence across stocks' returns and order flow may shed light on the effective interaction between the off-trading venue and the central market.

Here, we measure comovements between any pair of returns $R_{i,t}$ and $R_{j,t}$ by residual return correlations after controlling for the candidate explanatory variables.

2.6.1 Methodology

Intraday studies on common factors establish a time frame for the data series using 15-minute intervals (e.g. Habrouck and Seppi (2001), and Harford and Kaul (2002)). The use of a 15-minute time resolution is usually motivated by the need to find a balance between maximizing the number of intervals with non-missing observations and minimizing the feedback effects from returns to order flows.[11] For the purpose of this analysis we use a 30-minute time interval in order to avoid frequent cases of no price changes in a shorter time frame.[12]

To differentiate stochastic sources of common time-variation from deterministic sources, stock-specific and aggregate-level variables are standardized to remove the time-of-day effects. Let $y_{i,d,t}$ denote any generic observation for stock i for 30-minute interval t on day d. The standardized value is $y^*_{i,d,t} = (y_{i,d,t} - \mu_{i,k})/\sigma_{i,k}$ where $\mu_{i,t}$ and $\sigma_{i,t}$ are the mean and the standard deviation for stock i and interval t estimated across days. The standardization of variables also facilitates comparative analyses across stocks and through time.

Theoretical models of market microstructure establish that causation runs from trading activity to prices. We therefore relate individual stock's own returns to order flow variables as in the following specification:

$$R_{i,t} = \alpha + \beta_1 OF_{i,t} + \beta_2 OF^b_{i,t} + \beta_3 OF_{M,t} + \gamma_1 OF_{i,t-1} + \gamma_2 OF_{M,t-1} + \varepsilon_{i,t} \tag{2.6}$$

The specification in (2.6) is estimated separately for each stock i. Here, $R_{i,t}$ is the log quote midpoint return computed as $R_{i,t} = \log(m_{i,t}/m_{i,t-1})$, where $m_{i,t}$ is the midpoint of the bid and ask prices for stock i prevailing at the end of interval t. The quote midpoint is used in computing intraday returns in order to avoid bid-ask bounce. The independent variable $OF_{i,t}$ is cumulative order flow over each 30-minute interval for stock i and is calculated as the sum of the order flows over interval t. In computing the aggregate order flow $OF_{M,t}$, stock i is excluded, so the explanatory variables in (2.6) is slightly different for each stock's time series regressions. $OF^b_{i,t}$ is the cumulative block trade order flow over interval t for stock i. Order flow can be defined in terms of the number of transactions (the difference between the number of buys and the number of sells) or in terms of trading volume (which also incorporates the number of shares bought and sold). We use the order flow variable defined in terms of the number of transactions, in that prior research (e.g. Hasbrouck (1991)) has established that order flow based on the number of transactions is better behaved. One lag of the individual

[11] From the economic point of view, in the returns and order flow relation causality goes from order flow to returns. If the measurement interval is lengthened there is a increased risk of causality for feedback effects from prices into subsequent order submissions due to positive feedback strategies.

[12] Indeed, the 15-minute time resolution frequently gives rise to no price variations (zero standard deviation) over the interval. This leads to problems of matrix singularity in the estimation procedure.

stock and aggregate order flow is also included in specification (2.6) in order to capture any lagged adjustment in commonality.

We follow an approach similar to that employed by Harford and Kaul (2002) to assess the relative importance of block trading activity as a source of common effects. We sequentially add the sources of common effects to regressions that explain an individual stock's returns, and examine the increase in R-squared and the decrease in the pairwise correlation of the residual returns at each step. For our purpose we qualify the order flow variables in specification (2.6) as sources of common effects.

More specifically, we use the resulting estimated residuals from equation (2.6)

$$\begin{aligned} \widehat{e}_{it} &= R_{i,t} - \widehat{\alpha}_{it} - OF_{i,t}\widehat{\beta}_1 - OF^b_{i,t}\widehat{\beta}_2 - OF_{M,t}\widehat{\beta}_3 \\ &\quad + OF_{i,t-1}\widehat{\gamma} + OF_{M,t-1}\widehat{\gamma} \end{aligned} \tag{2.7}$$

to compute, for each $i \neq j$, the residual correlation coefficients

$$\widehat{\rho}_{ijt} = \frac{cov(\widehat{e}_{it}, \widehat{e}_{jt})}{[var(\widehat{e}_{it})var(\widehat{e}_{jt})]^{\frac{1}{2}}} \tag{2.8}$$

We then compute the following correlation coefficient for any stock $i = 1, ..., N$:

$$\widehat{\rho_{it}} = \frac{1}{N-1} \sum_{i=1, i \neq j}^{N} \widehat{\rho}_{ijt} \tag{2.9}$$

If block trading activity is a source of interdependence across stocks, the correlation of residual returns should decrease and R-squared should increase after adding regressor $OF^b_{i,t}$ in the sequential estimation procedure.

2.6.2 Empirical results

Table 2.11 reports the median regression coefficient from the estimation of equation (2.6). The coefficients on contemporaneous stock-specific and aggregate order flow is significantly positive. This is consistent with the notion that positive order flow leads to positive returns. The coefficient on block order flow is also positive although mildly significant (at 10% level). The magnitude of the block order flow impact on individual stock's own returns is quite small (about 0.04 basis points).

We then examine the change in the residual return correlation by a stepwise regression procedure. We estimate model (2.6) by adding the block order flow to stock-specific order flow. In a second estimation we add the aggregate order flow to individual stock's own order flow. In this manner we can assess the incremental contribution of the block order flow regressor by permuting the order in which it and the other regressors are added to the model. Table 2.12 reports the residual return correlation when we estimate the model sequentially starting with stock's own order flow and then adding the block order flow, and aggregate order flow. The last column reports the average pairwise correlation of standardized raw returns. The addition of a stock's order flow leads to a substantial reduction of the raw return correlation. When we add the block order flow to individual own's stock order flow, however, there is no change in the residual return correlation. After the aggregate order flow is added, the return correlation drops substantially.

Our results suggest that stock's own order flow is the main source of the return correlation, followed by the aggregate order flow. This result is in line with the findings by Harford and Kaul (2002). The fact that there is no substantial change in the residual return correlation once the block order flow regressor is added implies that block order flow has a small significant impact on stock's own returns, but *per se* block order flow leads to no common effects across stocks. This is not surprising since block trades tend to be infrequent and are transactions of specific stocks.

2.7 Conclusions

Using intraday data from the Italian Exchange, this paper investigates the effects on price and market liquidity of upstairs trading activity when there is no constraint for upstairs traders to execute large-block trades at better or equivalent prices in the central market.

Consistently with previous work, we document asymmetric permanent price effects for block purchases. Central market prices increase over the 60-minute timespan following the block transaction. However, the magnitude of the post-trade effects is small. This is in contrast with the findings by Gottardo and Murgia (2000), who document no evidence for post-trade price impacts for block purchases on the Italian Exchange. A deeper examination of price impacts reveals that block purchases also induce short term liquidity costs, a price effect which is typically associated with block sales. This puzzling outcome, which is consistent with Gottardo and Murgia (2000) but in contrast with previous work on other equity markets, may be explained by the fact that on the Italian Exchange it is common for the large shareholders to act as counterparties in block transactions. We also document no evidence of leakage effects for block purchases, while block sales induce significant price impacts before block execution. Overall, our results are mostly consistent with explanations of liquidity costs and price pressure induced by large block trades.

We then examine the effects of large-block trades on market liquidity. Our results show that before and after block trades there is an increase rather than a decrease of liquidity. It may be that large block transactions solve rather than increase the information asymmetry, and consequently induce greater liquidity. Although the magnitude of the impact of block trades on liquidity is significant, we find that there is no substantial change in the magnitude of the impact. This pattern is more evident from the analysis in transaction event time. Overall, our finding that block trades induce greater liquidity provides further support to previous evidence that upstairs trading activity is not harmful to downstairs liquidity.

We finally study whether block trading is a common factor in trading activity, that is whether it gives rise to interdependence in returns across stocks. The purpose of this investigation is to uncover the extent to which the upstairs and the central market effectively interact. While we find that block trades yield positive impacts on individual stock's own returns, there is no evidence that block trading activity *per se* leads to correlated returns across stocks.

In sum, our findings are consistent with the notion that an upstairs trading mechanism is needed for the supply of wholesale liquidity that retail markets are not able to accommodate and for institutional investors who want to avoid splitting their block in order to reduce trading costs.

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Block type	Buy blocks		Sell blocks	
	Volume in value	Volume in share	Volume in value	Volume in share
Number	127	127	58	58
Mean	5.915	20.691	3.881	0.911
Median	0.900	0.900	2.783	0.420
Std dev	10.835	4.551	3.781	1.120
Min	1.500	0.054	1.554	0.057
Max	85.595	42.798	25.810	6.00

Table 2.1: Summary statistics for the distribution of large-block trades in November 2001

This table reports summary statistics for the distribution of large-block trades during November 2001. Block share and block value volumes are expressed in million shares and Euro, respectively.

PANEL A						
Upstairs market						
trade size	Block volume in share (th shares)			Block volume in value (ML Euro)		
(percentile)	N	Mean	Median	N	Mean	Median
≺25%	40	552.11	650.00	40	1.93	1.81
[25%; 50%)	43	799.65	725.00	43	2.76	2.55
[50%; 75%)	46	1143.85	905.00	46	3.67	3.17
[75%; 90%)	22	2115.00	2750.00	22	6.20	5.57
[90%; 95%)	5	6293.54	7897.74	5	13.06	12.21
⪰95%	29	4432.38	1105.00	29	14.09	4.05
PANEL B						
Downstairs market						
trade size	Volume in share			Volume in value		
(percentile)	N	Mean	Median	N	Mean	Median
≺25%	365650	0.21	0.20	365650	1.10×10^{-3}	8.6×10^{-4}
[25%; 50%)	546320	0.82	0.50	546320	3.65×10^{-3}	2.97×10^{-3}
[50%; 75%)	510934	2.53	1.85	510934	1.14×10^{-2}	8.43×10^{-3}
[75%; 90%)	310125	6.58	4.75	310125	2.97×10^{-2}	2.40×10^{-2}
[90%; 95%)	98400	11.55	8.62	98400	5.72×10^{-2}	4.80×10^{-2}
⪰95%	106497	29.73	19.45	106497	1.20×10^{-1}	8.24×10^{-2}

Table 2.2: Distribution of upstairs and downstairs transactions by trade size

The table reports the mean and median trade size of upstairs and downstairs trade volume in share and in value. The block and downstairs trade size cut-offs in each group are determined based on each firm's upstairs and downstairs trade size distribution, respectively. Share and value volumes are expressed in thousand shares and million Euro, respectively.

	Common sample				
	N	temporary effect	info-leakage effect	post-trade effect	total effect
midquote at 30 minutes	132	2.98×10^{-3}(0.000)	0.000(0.970)	0.000(0.150)	2.62×10^{-3}(0.000)
midquote at 60 minutes	116	3.77×10^{-3}(0.000)	2.03×10^{-4}(0.704)	8.34×10^{-4}(0.079)	3.26×10^{-3}(0.000)

Table 2.3: Price effects associated with large-block trades: common sample

This table presents the median components of price effects for the whole sample of block transactions. Temporary effects are computed as $\ln(P_b) - \ln(P_1)$, where P_b is the block price, P_1 is the measure of the post-trade value. Permanent price changes are divided into information leakage and post-trade component effects. The information leakage component is calculated as $\ln(P_0) - \ln(P_d)$ where P_d is proxied by the midpoint of the quotation at 30 and 60 minutes prior to the block trade. The post-trade impact reflects the price change after the block trade is executed: $PT = \ln(P_1) - \ln(P_0)$ where P_0 is the pre-trade value of the stock proxied by the last midquote before the execution of the block trade. The total execution cost is the sum of the temporary and permanent components: $TT = \ln(P_b) - \ln(P_d)$. The price effects are unadjusted and are stated in basis points. Statistical significance for the median is from the Wilcoxon signed rank test under the null hypothesis that the price effect is zero. P-values are provided for the median.

	Seller-initiated block trades				
	N	temporary effect	info-leakage effect	post-trade effect	total effect
midquote at 30 minutes	43	$-2.99 \times 10^{-3}(0.000)$	$1.49 \times 10^{-3}(0.152)$	$-1.52 \times 10^{-3}(0.066)$	$-2.44 \times 10^{-3}(0.003)$
midquote at 60 minutes	38	$-2.6 \times 10^{-3}(0.002)$	$2.25 \times 10^{-3}(0.052)$	0.000(0.947)	$-6.49 \times 10^{-4}(0.312)$

Table 2.4: Price effects associated with large-block trades: seller-initiated block trades

This table presents the median components of price effects for seller-initiated block trades. Temporary effects are computed as $\ln(P_b) - \ln(P_1)$, where P_b is the block price, P_1 is the measure of the post-trade value. Permanent price changes are divided into information leakage and post-trade component effects. The information leakage component is calculated as $\ln(P_0) - \ln(P_d)$ where P_d is proxied by the midpoint of the quotation at 30 and 60 minutes prior to the block trade. The post trade impact reflects the price change after the block trade is executed: $PT = \ln(P_1) - \ln(P_0)$ where P_0 is the pre-trade value of the stock proxied by the last midquote before the execution of the block trade. The total execution cost is the sum of the temporary and permanent components: $TT = \ln(P_b) - \ln(P_d)$. The price effects are unadjusted and are stated in basis points. The p-value for the median is from the Wilcoxon signed rank test under the null hypothesis that the price effect is zero.

	Buyer-initiated block trades				
	N	temporary effect	info-leakage effect	post-trade effect	total effect
midquote at 30 minutes	89	0.015(0.000)	0.000(0.421)	1.03×10^{-3}(0.004)	0.011(0.000)
midquote at 60 minutes	78	0.014(0.000)	-8.53×10^{-4}(0.686)	1.54×10^{-3}(0.025)	0.013(0.000)

Table 2.5: Price effects associated with large-block trades: buyer-initiated block trades

This table presents the median components of price effects for seller-initiated block trades. Temporary effects are computed as $\ln(P_b) - \ln(P_1)$, where P_b is the block price, P_1 is the measure of the post-trade value. Permanent price changes are divided into information leakage and post-trade component effects. The information leakage component is calculated as $\ln(P_0) - \ln(P_d)$ where P_d is proxied by the midpoint of the quotation at 30 and 60 minutes prior to the block trade. The post trade impact reflects the price change after the block trade is executed: $PT = \ln(P_1) - \ln(P_0)$ where P_0 is the pre-trade value of the stock proxied by the last midquote before the execution of the block trade. The total execution cost is the sum of the temporary and permanent components: $TT = \ln(P_b) - \ln(P_d)$. The price effects are unadjusted and are stated in basis points. The p-value for the median is from the Wilcoxon signed rank test under the null hypothesis that the price effect is zero.

Minutes from block trade (t_0)	N	S	D	QS	log QS
t_0-60	116	−0.050	−0.127	−0.060	−0.047
		(0.004)	(0.930)	(0.006)	(0.028)
t_0-30	132	−0.062	−0.236	−0.086	−0.062
		(0.000)	(0.013)	(0.000)	(0.000)
t_0+30	132	−0.058	−0.185	−0.091	−0.073
		(0.000)	(0.894)	(0.000)	(0.000)
t_0+60	116	−0.088	−0.062	−0.107	−0.091
		(0.000)	(0.582)	(0.000)	(0.000)

Table 2.6: Abnormal liquidity measures in clock time: common sample

This table reports the median liquidity measures computed as percentage deviation from their mean over non-event period at time t. S denotes the spread scaled by the midquote, D denotes the inside depth, QS and logQS denote the quote slope and the log quote slope, respectively. All liquidity measures are computed as the percentage deviation from the respective mean liquidity measures over normal trading days. The p-value for the median is from the Wilcoxon signed rank test under the null hypothesis that there is no abnormal liquidity.

Minutes from block trade (t_0)	N	S	D	QS	log QS
t_0-60	38	-0.061	-0.293	-0.050	-0.046
		(0.016)	(0.172)	(0.031)	(0.034)
t_0-30	43	-0.066	-0.196	-0.071	-0.073
		(0.022)	(0.117)	(0.044)	(0.048)
t_0+30	43	-0.062	-0.348	-0.091	-0.089
		(0.000)	(0.422)	(0.009)	(0.001)
t_0+60	38	-0.093	-0.075	-0.101	-0.089
		(0.000)	(0.202)	(0.001)	(0.006)

Table 2.7: Abnormal liquidity measures in clock time: block sales

This table reports the median liquidity measures for seller-initiated block trades are computed as percentage deviation from their mean over non-event period at time t. S denotes the spread scaled by the midquote, D denotes the inside depth, QS and logQS denote the quote slope and the log quote slope, respectively. All liquidity measures are computed as the percentage deviation from the respective mean liquidity measures over normal trading days. The p-value for the median liquidity measure is from the Wilcoxon signed rank test under the null hypothesis that there is no abnormal liquidity.

Minutes from block trade (t_0)	N	S	D	QS	log QS
t_0-60	78	−0.041	−0.334	−0.066	−0.047
		(0.078)	(0.443)	(0.055)	(0.028)
t_0-30	89	−0.050	−0.248	−0.104	−0.057
		(0.000)	(0.050)	(0.000)	(0.007)
t_0+30	89	−0.045	−0.100	−0.091	−0.065
		(0.000)	(0.718)	(0.001)	(0.019)
t_0+60	78	−0.080	−0.105	−0.108	−0.092
		(0.000)	(0.757)	(0.000)	(0.000)

Table 2.8: Abnormal liquidity measures in clock time: block purchases

This table reports the median liquidity measures for buyer-initiated block trades are computed as percentage deviation from their mean over non-event period at time t. S denotes the spread scaled by the midquote, D denotes the inside depth, QS and logQS denote the quote slope and the log quote slope, respectively. All liquidity measures are computed as the percentage deviation from the respective mean liquidity measures over normal trading days. The p-value for the median liquidity measure is from the Wilcoxon signed rank test under the null hypothesis that there is no abnormal liquidity.

	Quote relative to trade of interest (trade 0)									
	-5	-4	-3	-2	-1	1	2	3	4	5
Common	-0.093	-0.093	-0.093	-0.093	-0.093	-0.093	-0.093	-0.093	-0.093	-0.093
	(-4.593)	(-4.592)	(-4.591)	(-4.591)	(-4.592)	(-4.592)	(-4.593)	(-4.593)	(-4.593)	(-4.592)
Purchases	-0.040	-0.040	-0.040	-0.040	-0.040	-0.040	-0.040	-0.040	-0.040	-0.040
	(-5.503)	(-5.509)	(-5.513)	(-5.513)	(-5.508)	(-5.519)	(-5.514)	(-5.514)	(-5.505)	(-5.510)
Sales	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038
	(-4.127)	(-4.125)	(-4.124)	(-4.124)	(-4.125)	(-4.127)	(-4.127)	(-4.127)	(-4.127)	(-4.126)

Table 2.9: Excess spread in transaction time

This table reports mean excess spreads relative to common sample, block purchases and block sales. Mean excess spreads are spreads in excess of a benchmark level, computed using spreads -20 through -11 relative to block trade of interest. The t-statistic for the test that the mean excess spread equals zero is reported in brackets.

	Quote relative to trade of interest (trade 0)									
	-5	-4	-3	-2	-1	1	2	3	4	5
Common	-10.849	-10.843	-10.839	-10.861	-10.844	-10.848	-10.849	-10.849	-10.843	-10.844
	(-5.964)	(-5.963)	(-5.960)	(-5.972)	(-5.963)	(-5.964)	(-5.965)	(-5.966)	(-5.962)	(-5.961)
Purchases	-1.135	-1.134	-1.134	-1.134	-1.133	-1.133	-1.133	-1.133	-1.136	-1.127
	(-5.180)	(-5.178)	(-5.174)	(-5.184)	(-5.186)	(-5.183)	(-5.182)	(-5.185)	(-5.184)	(-5.185)
Sales	-1.540	-1.539	-1.538	-1.540	-1.539	-1.542	-1.542	-1.543	-1.543	-1.543
	(-2.850)	(-2.850)	(-2.850)	(-2.850)	(-2.850)	(-2.851)	(-2.851)	(-2.851)	(-2.851)	(-2.850)

Table 2.10: Excess depth in transaction time

This table reports mean excess depths relative to common sample, block purchases and block sales. Excess depths are expressed in number of shares and divided by 100,000. Mean excess depths are depths in excess of a benchmark level, computed using depths -20 through -11 relative to block trade of interest. The t-statistic for the test that the mean excess depths equals zero is reported in brackets.

	Intercept	$OF_{i,t}$	$OF^b_{i,t}$	$OF_{M,t}$	$OF_{i,t-1}$	$OF_{M,t-1}$	adj R^2
Median	-1.28×10^{-4}	2.66×10^{-3}	3.79×10^{-4}	6.42×10^{-5}	-3.79×10^{-4}	-2.93×10^{-5}	0.423
p-value	0.044	0.000	0.078	0.000	0.000	0.000	0.000

Table 2.11: Median regression coefficients. Commonality in order flow and returns

This table reports the adjusted R^2 and the cross-sectional median regression coefficients of equation (2.6). The intraday midquote returns $R_{i,t}$ is regressed on order flow variables at stock-specific $OF_{i,t}$ and $OF^b_{i,t}$ and aggregate level $OF_{M,t}$. The p-value is a Wilcoxon signed rank test that the cross-sectional median regression coefficient equals zero.

	Corr	Adj R^2	Corr R
Just Own OF	0.192	0.371	0.416
	0.000	0.000	0.000
Add OF^b	0.192	0.371	0.416
	0.000	0.000	0.000
Add OF_M	0.146	0.407	0.416
	0.000	0.000	0.000

Table 2.12: Correlation of residual return estimates

This table reports the average pairwise correlation of the residual returns and the adjusted R^2 of the stepwise regression estimation in equation (2.6). The last column report the average pairwise correlation in raw returns standardized by the time-of-day effects. We estimate the model $R_{i,t} = \alpha + \beta_1 OF_{i,t} + \beta_2 OF^b_{i,t} + \beta_3 OF_{M,t} + \gamma_1 OF_{i,t-1} + \gamma_2 OF_{M,t-1} + \varepsilon_{i,t}$ sequentially by adding stock's own order flow (Just Own OF) first, then the block order flow (OF^b), and finally the aggregate order flow (OF_M). The p-value from the Wilcoxon signed rank test that there is no correlation in residual returns.

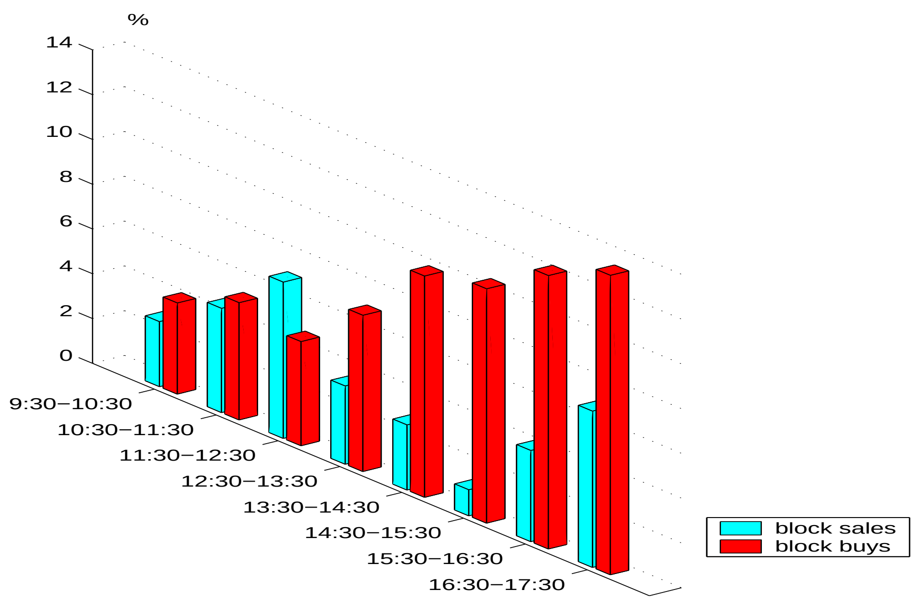

Figure 2.1: Intraday distribution of block trades in November 2001 by the number of block sells and block purchases

This figure shows the intraday percentage distribution of the number of block trades by time intervals and block type during the regular trading hours in November 2001.

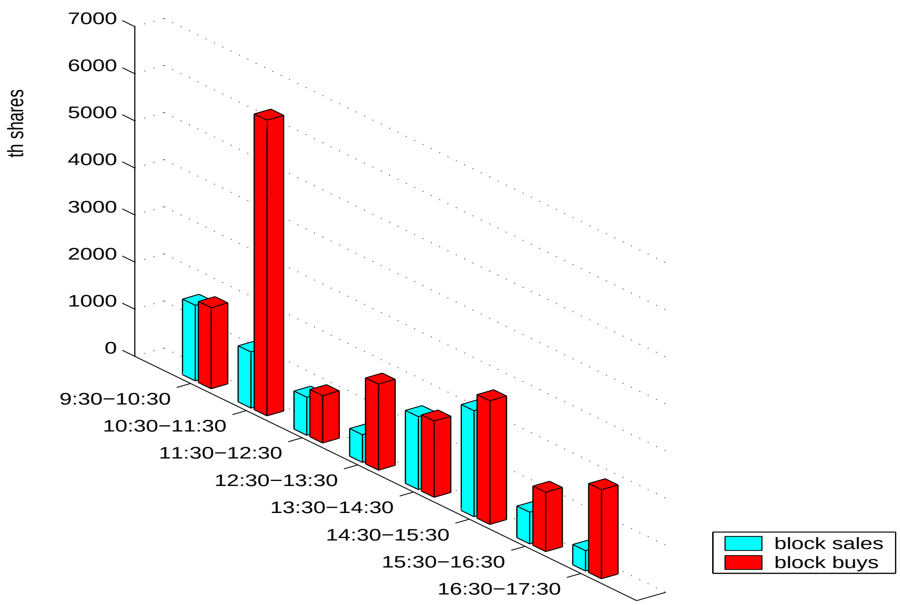

Figure 2.2: Intraday distribution of block trades in November 2001 by the average block volume of block sells and block purchases

This figure shows the intraday distribution of the average volume in thousand of shares of block trades by time intervals and block type during the regular trading hours in November 2001.

Chapter 3

Intraday and interday effects in block trading activity: Evidence from the Italian Exchange

3.1 Abstract

This paper examines the intraday and interday effects of block trading activity on the Italian Exchange. Results from the analysis of the cross-sectional variations of the current impact show no differential effects depending on the block-initiator: the mean current impact is significantly different on Thursdays for both block purchases and block sales. The purchase block order flow appears to be concentrated in the last two trading hours, while, at intraweek level, it tends to be executed on Wednesdays and Thursdays. Block sales tend to be executed in the last trading hour and on Tuesday, Thursday and Friday. Intraday tests of the cost of executing block trades show that the cost for block purchases differs significantly from 11:30 to 12:30 A.M. and in the last two trading hours. There is no significant evidence for intraweek effects. Also block sales show a similar pattern. Overall, intraday segmentation appears to be stronger than interday variations in block trading activity without differential variations depending on the block-initiator.

3.2 Introduction

Researchers have largely documented regular differences in stock market activity and in the return process for various hours of the day and day of the week. Among others, French (1980), Lakonishok and Levi (1982), Keim and Stambaugh (1984), and Rogalski (1984) report that the average return on Monday is significantly less than the average return during the other days of the week. Jaffe and

Westfield (1985) and Chang et al. (1993) provide international evidence in support of the day-of-the-week effects.

One important implication of the existence of such anomalies is that any predictable pattern in asset returns may be exploitable and therefore judged as evidence against efficiency of asset markets. Day-of-the-week effect patterns in returns might enable investors to take advantage of relatively regular shifts in the market by designing trading strategies, which accounts for such predictable patterns. For instance, investors may define dynamic trading strategies which take into account this kind of inefficiency instead of the simple "buy-and-hold" strategy. Any investor who would like to profit from the negative returns for Monday may purchase the market index every Monday afternoon and then sell these investments on Friday afternoon, holding cash over the weekend. However, because of transaction costs, these trading strategies may not be able to generate the expected profits.

In this paper we examine the intraday and interday effects of block trading activity using data of the Italian Stock Exchange. This time-dependent analysis of block trading activity is interesting because it provides insights into the behavior of informed traders and discretionary liquidity traders. Theoretical models of market microstructure recognize the role of discretionary liquidity traders in accentuating inter- and intraday variations in market volatility and volume patterns since these traders avoid trading in times when trading costs are the highest.

Past research has focused on intraday and interday changes in trading and liquidity patterns in the regulated market. An earlier attempt to address this issue is the paper by Choe, McInish and Wood (1995). This paper investigates the relationship between the number of block trades over the trading day and across exchanges. In general, for each day of the week, the ratio increases from the first to the second period, declines through the period ending at 3:30 p.m., and increases for the last 30-minute period. Periods with increased small trading activity experience a more than proportionate increase in block trades. Differences across exchanges in the intraday pattern of block trades in relation to smaller trades are reported. However, the paper arbitrarily defines a block trade (larger or equal to 20,000 shares). In addition, the analysis focuses on trading activity in the regulated market. By their nature, large-block trades cannot be handled in the regulated market. Here we investigate whether and how temporal patterns in block trading activity differs from temporal regularities in the central market. This may also shed light on a pattern typically observed in the stock market called "parallel trading" (Kraus and Stoll, 1972a). This is a situation in which groups of institutions tend to trade in the same way at the same time. Examination of parallel trading is important because it provides a framework for defining relationships between trading by institutional investors and trading by individuals in the central market.

For our purpose we first examine interday variations in the current impact of block trades on stock returns. We employ a measure similar to that defined by Kraus and Stoll (1972b). We then investigate interday and intraday variations in block order flow and the estimated cost of liquidity. We employ a nonparametric test equivalent to the ANOVA to investigate potential inter- and intraday effects in cost of execution for block trades. Nonparametric methods allow us to control outliers better.

The remainder of this paper is organized as follows. Next section provides an overview of the literature. In section 3.4 the data used are described and the methodology is outlined. Section 3.5 provides empirical results for intraday and interday tests. Concluding remarks are presented in section 3.6.

3.3 Review of the literature

There is a burgeoning body of evidence of temporal patterns in stock market return volatility and volume. A group of these studies focus on calendar anomalies. Cross (1973) studies the returns on the S&P 500 Index over the period of 1953 and 1970. His findings indicate that the mean return on Friday was higher than the mean return on Monday. Similar results were reported by French (1980), who also studied the S&P 500 index for the period from 1953 to 1977. Specifically, French (1980) examines the process generating stock returns by comparing the returns for different days of the week. Two hypotheses of return generating processes are advanced. Under the calendar time hypothesis, the process operates continuously and the expected return for Monday is three times the expected return for other days of the week. Under the trading time hypothesis, returns are generated only during active trading and the expected return is the same for each day of the week. French finds that the mean return for Monday is significantly negative over the 25-year sample he examined. His findings suggest that neither the calendar time nor the trading time hypothesis can fully explain the nature of the negative expected returns. He also compares market returns for days following holidays with the "non-holiday' returns in order to test whether the negative returns systematically occur only on Mondays or they reflect some "closed-market' effect. If the negative returns arise after any day that the market is closed, the expected return will be lower following holidays as well as weekends. His finding that 'non-holiday' returns are negative for Monday suggests that the persistently negative returns for Monday are caused by some weekend effect rather than by closed-market effect.

Rogalski (1984) addresses directly the question of whether prices fall between Friday close and Monday opening or during the day on Mondays. He provides evidence that all of the average negative returns from Friday close to Monday close occur during the non-trading hours (non-trading weekend anomaly), while average trading day returns (open to close) are identical for all days. His results show that the Monday and non-trading weekend effects are directly related to the January effect. He finds that the Monday effect and the non-trading effect are on average positive in January and on average negative for the rest of the year. This anomaly is also related to firm size. Rogalski shows that close to close returns of small firms on Mondays in January are on average positive and greater than corresponding positive returns for large firms. Thus, the January effect appear to dominate the Monday effect. Indeed, this January/firm size finding holds for all days of the week. When considering the rest of the year, the negative returns on Monday are still present across firms, but a relation between the Monday effect and firm size is not evident.

Harris (1986) extends the previous works by using transaction data to account for weekly and intradaily patterns in stock prices. Consistently with previous work, he finds significant negative Monday close-to-close returns, however this pattern is different across firms. For large firms, the close-to-open return is greater in absolute value than the open-to-close returns, and for small firms, just the opposite. He is not able to explain the reason for this different pattern across firms. An investigation into intraday patterns reveals that the negative Monday returns actually occur only in the first forty-five minutes while there is no evidence for such a pattern for the other weekdays at the same time. His findings indicate that Wednesday returns are also significantly different from other weekdays.

Some interesting results on joint characteristics of common stock trading volume and returns are provided by Jain and Joh (1988). These authors use data on the New York Stock Exchange within and across days of the week for the years 1979 to 1983. Their findings reveal that average trading volume follows a U-shape pattern: it is highest during the first hour of the day (from 10:00 A.M. to 11:00 A.M.) for each day of the week, then declines monotonically until 2:00 P.M. and increases again in the last two trading hours. A distinct pattern is also evident across the days of the week. The average trading volume is lowest on Monday, goes up monotonically from Monday to Wednesday, and then declines monotonically on Thursday and Friday. This pattern is observed for each hour of the day. Jain and Joh find also that average stock returns across hours are also significantly different. Comparisons across days reveal that for the first hour, average returns across days are significantly different. For each hour except the first, however, the return averages do not differ significantly across days. The regularities they observe across hours and days persist over years and are not period-specific.

Theoretical models of microstructure ascribe these stocks' returns patterns to the existence of information asymmetry on stock markets. Admati and Pfleiderer (1989) demonstrate that day-of-the-week effects can arise as a conseguence of the market-making process and the presence of privately informed traders. In their model, market makers "divide" informed traders from liquidity traders by buying, say, only on even-numbered days and selling only on odd-numbered days. Because information is assumed to be short-lived, this strategy discourages investors from obtaining costly information and allows market makers to avoid the costs of trading with informed traders. Systematic switches between bid and ask quotes induce predictable variation in intraweek returns. Similarly, Foster and Viswanathan (1990) put forward the hypothesis that the different pattern in trading costs, trading volume and return volatility throughout the weekdays is the result of the trading strategies of informed traders and discretionary liquidity traders. The quality of the public information is crucial to determine the interday variation of these variables. If public information is precise and the informed trader has more private information, then discretionary liquidity traders delay their trades. Because the informed trader's information advantage is short-lived, the delay tactic of discretionary liquidity traders leaves less liquidity in the market and makes it easier for the market maker to infer the informed trader's reasons for trading. As a conseguence, the volume is lower, prices are more informative (volatile), and trading costs are higher. The adverse selection problem becomes more severe over a weekend. The result is that discretionary liquidity traders pospone their transactions, and Monday's volume should be the lowest of any day of the week. Foster and Viswanathan argue that larger stocks should be more likely to have lower trading volume on Monday because of more reliable flow of public information.

Admati and Pfleiderer (1988), and Foster and Viswanathan (1990) recognize the important role of discretionary liquidity traders in accentuating intra- and interday patterns. In the Admati and Pfleiderer model, discretionary liquidity traders are given the freedom to choose at what time of day they trade; in equilibrium, all discretionary liquidity traders choose to trade at the same time of day. While this pooling of trades attracts informed traders, Admati and Pfleiderer show that this strategy minimizes the trading costs of discretionary liquidity traders. While more informed traders submit orders in response to this concentration of liquidity, competition among these traders ensures that adverse selection trading costs are even lower. Hence, in the Admati and Pfliederer model, for intraday transactions trading costs are low when trading volume is high and prices are more volatile. Conversely, Foster and Viswanathan (1990) predict that trading costs are low when trading volume is high and prices are less volatile.

In their empirical analysis, Foster and Viswanathan (1993) show that there is a strong variation in trading volume and return volatility at intraday level. There is a concentration of volume in the opening half hour of trading and the return volatility is significantly different across trading hours. Their interday tests reveal that Monday's trading volume is significantly lower than Tuesday's and Wednesday's trading volume for the most actively traded firms but they fail to detect strong variations for return volatility. Their results suggest that trading volume is high when volatility is high for the intraday case (volume is highest and returns are most volatile at the open), but not for the interday case (they find no strong interday variations in return volatility). The evidence for intraday case appears to support the Admati and Pfleiderer's predictions for return volatility and trading volume. Consistent with the predictions of Foster and Viswanathan (1990), Foster and Viswanathan (1993)'s results from the interday tests indicate that low adverse selection trading costs occur at the same time as high trading volume for the most actively traded firms, while the evidence of significant positive relation between the adverse selection trading costs and trading volume appears to be inconsistent with the Admati and Pfleiderer model. The authors conclude that, overall, neither the Admati and Pfleiderer or Foster and Viswanathan models cannot explain the fact that trading volume is highest when trading costs are high for intraday tests.

3.4 Data and summary statistics

Our dataset consists of time-stamped records of block transactions from October through December 2001. The dataset for block trades contains the name of the stock traded, the date and the time of execution, the block price per share net of the commissions and the quantity (number of shares) of the block trade.

Table 3.1 shows the summary statistics for block trades in value by day of the week. Figure 3.1 and figure 3.2 exhibit the distribution of the number and block trades in value of all block trades, respectively. The most notable pattern we can observe is that block trades tend to be executed over the last two weekdays, but in particular on Thursdays. Thursday only accounts for 66% of block trades executed in our sample period.

We then distinguish between block trades executed over the regular and off the regular trading sessions. We examine the temporal distribution of block order flow measured in terms of the number of block trades, and the block trade in share and in value. All these variables are expressed in percentage terms over their total amount during the whole sample period. On the Italian Exchange the publication of block trades executed during the regular trading session is one hour after block execution, while block trades executed off the regular trading hours are disclosed by 9:00 A.M. of the next day. Hence, we may expect that the more informed a block trade, the larger the number of block trades executed outside the normal trading session. Figure 3.3 shows that block trades are mostly executed during the regular trading sessions. During the regular trading hours, Thursday accounts for almost 20% of block trades executed. Block trades executed off the regular trading hours account for about 7% on the same weekday. Block order flow is lower on the first two weekdays, then it increases from Wednesday and remains constant until Friday.

Figure 3.4 exhibits a different pattern for the distribution of block trades in value. During the regular session, the value amount of block trades appears to be the highest on Thursday (almost 330%), whereas the total amount of block trades executed outside the regular trading hours appears to be highest on Friday (about 70%). Overall, the pattern observed for the block order flow and the amount of block trades in value executed during and outside the regular trading session appear to reflect trading motivations beyond those driven by private information.

For the purpose of our intraday and interday tests and the limitations of our dataset, we focus on block trades that execute during the continous auction time (from 9:30 A.M. to 5:30 P.M.).[1] We follow a procedure similar to that suggested by Lee and Ready (1991) to infer block trade initiation. If the block price at time t is higher (lower) than the transaction price in the central market at time $t-1$, the block trade is buyer- (seller-) initiated. For zero-tick block we relied on the midpoint quotation at time $t-1$ the execution of the block trade. We omit from our analysis block trades for which we cannot identify the block-initiator because transaction and order data on the day the block trade occurs are not available. We also release those block trades for which no quotes are available at time

[1]Because of the introduction of the closing auction in December 2001, the daily trading session ends five minutes earlier. The closing auction has been introduced with the view to increase liquidity at the end of the continuous trading. However, this does not affect our results.

$t-1$. After this filter procedure, we are left with 392 block trades over the sample period, of which 232 are block purchases and 160 are block sales.

Table 3.2 and table 3.3 report descriptive statistics for block purchases and block sales, respectively. A comparative analysis reveals that block purchases show larger variability than block sales. The block size for block purchases is larger than for block sales and shows a great deal of variability across days of the week. A deeper investigation of the distribution of block trades by day of the week reveals that block trading activity for both block purchases and block sales is less intensive on Monday. The number of block purchases (table 3.2) gradually increases from Tuesday to Thursday and decreases on Friday. Almost 29% of block purchases are executed on Thursday. The examination of the intraday pattern of the number of block purchases (figure 3.5) reveals that the purchase block order flow tends to increase over trading hours on Thursday and Friday, in particular during the last two trading hours (about 20% of the total number of block purchases are executed on each of these weekdays). Another notable pattern is that the buy block order flow is higher during the first trading hour (from 9:30 A.M. to 10:30 A.M.) on Friday than in any other hour of any weekday. At interday level, Friday is the weekday on which the buy block order flow is the highest. The percentage distribution of buy block trade in share and in value (figure 3.6 and figure 3.7, respectively) show a similar pattern. Both the buy block trades in share and in value appear to be the largest during the last trading hour (about 80% and 85%, respectively), notably on Thursday and Friday.

The examination of block sales patterns reveals that they show different interday behavior. From Table 3.3 we note that, except for Monday, the number of blocks executed appears to be constant, also the block size shows less variability. At intraday level, (figure 3.8), the sale block order flow appears to reach the peak in the last trading hour (about 25%) and from 11:30 A.M to 12:30 A.M. (about 18%). At intraweek level, Friday accounts for the highest number of block sales executed.

Figure 3.9 and figure 3.10 show the percentage distribution of sale block trade in share and in value, respectively, by trading hours throughout the weekdays. We note that block sales in share and in value are lower than block purchases. Overall, the amount of sale blocks executed tends to be concentrated in the last trading hour at intraday level, and on Friday at intraweek level.

3.5 Empirical results

3.5.1 Interday variations in current impact

The effect of block trades on stocks' returns is largely studied in block trading literature. Typically, an event study methodology is employed to assess the cumulative impacts of block trade on stocks' returns in a time period around the block trade. Here our purpose is to detect within-day impacts of block trades on stocks' returns throughout weekdays. We employ a measure of the impact similar to that defined in Kraus and Stoll (1972b). For each block trade b of stock j, we compute

$$U_{b,d} = R_{b,d} - (\alpha + \beta R_{m,d}) \quad (3.1)$$

Here, $U_{b,d}$ captures the effect of a block trade on the stock j's returns on day d when the block trade b occurs. $U_{b,d}$ may be viewed as a measure of the current impact on the individual stock return on day d when a block trade b occurs. $R_{b,d}$ is the daily close-to-close return for stock j which experiences a block trade b on day d and is computed as $R_{b,d}=ln(\frac{P_d}{P_{d-1}})$. $R_{m,d}$ is the return on the MIB30 Index on day d when a block trade b occurs.[2]

In order to assess the robustness of our estimates, we run different versions of equation 3.1. In a first version we regress the current impact $U_{b,d}$ on $R_{b,d}$ and $R_{m,d}$ on days block trades occur.[3] In another version we run the market-adjusted return model by assuming that, for each stock, α tends to zero and β tends to one.[4] The current impact $U_{b,d}$ is computed as the difference between $R_{b,d}$ and $R_{m,d}$ on the day the block trade b occurs. In a last version, for each stock we estimate the parameters of the market model over the whole sample period.[5] The current impact $U_{b,d}$ is then computed using the $R_{b,d}$ and $R_{m,d}$ on the day the block trade occurs. To examine the interday variations in stocks' daily residual returns we run the regression

$$U_b = \alpha_b + \sum_{d=2}^{5} \gamma_{b,d} D_{b,d} + \varepsilon_b \quad (3.2)$$

In this specification, the dummy variables indicate the day of the week on which the block trade b occurs. The mean current impact for Monday is measured by α, while γ_d, $d = 2$ to 5, represent the difference between the mean current impact for Monday and the mean return for each of the other days of the week. To test the equality of the means across days, an analysis of variance is performed. If the mean curren impact is the same for each day of the week, the estimates of the mean current impact γ_d will be close to zero and an F-statistic measuring the joint significance of the dummy variables should be insignificant.

Table 3.4 reports the results of the cross-sectional variation in the current impacts of block trades throughout the weekdays when α and β are directly estimated from the market model. The estimates

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[2]The return on the market index $R_{m,d}$ is computed as $R_{m,d}=ln(\frac{P_{m,d}}{P_{m,d-1}})$, where $P_{m,d}$ is the closing price of the Index on day d. The closing values for the market index MIB30 are obtained from Datastream.

[3]The value for $\hat{\alpha}$ and $\hat{\beta}$ for the common sample is 0.0054(3.779) and 0.0863(1.059), respectively; 0.0044(2.346) and 0.1080(0.968) for block purchases; 0.0072(3.181) and 0.027(0.222) for block sales. The t-statistics are in parenthesis.

[4]This is the same assumption in Kraus and Stoll (1972b).

[5]The mean estimate for $\hat{\alpha}$ is 0.0022629, whereas the mean estimate for $\hat{\beta}$ is 0.0085714. Both are significant at no convenient significance level.

for the common sample indicate that the observed current impact are different across weekdays. The F-statistic, testing the hypothesis that γ_2 through γ_5 are zero, is statistically significant at 1% level. The coefficient for Monday is negative but it is not statistically significant. The estimated coefficients on other weekdays are positive but not statistically significant except for Thursday. The magnitude of the current impact on Thursday is roughly 2% higher than the level for Monday. We then turn to investigate whether there are interday effects depending on block initiator. For block purchases, we cannot reject the hypothesis that all mean current impacts are equal from Tuesday through Friday. The inspection of mean current impacts on individual weedays reveals that the only weekday on which we find significant coefficient is Thursday. The mean current impact is positive and significant at 5% level. Also block sales show a similar pattern. Results from the F-statistic test provide significant evidence for interday variations in current impacts at 1%. The inspection into the mean current impact on individual weekdays reveals that also for block sales the mean current impact on Thursday is statistically significant. A comparison of the magnitude of the estimated parameter for block purchases and block sales indicates that the current impact for block sales on Thursday is slightly larger than for block purchases.

Table 3.5 and Table 3.6 report the results of the ANOVA regressions, respectively, when assuming α tends to zero and β tends to one, and when both α and β are from the market model estimated over the sample period. All of these results show that the mean current impact is significant on Thursday.

3.5.2 Intraday and interday variations in block order flow

Here we employ the block order flow measured in terms of the number of block trades to investigate whether or not, and if so, how segmentation arises in block trading activity. We employ the analysis of variance to test intraday and intraweek variations in the block order flow:

$$OF_t = OF + \sum_{t=2}^{5} \gamma_t + \varepsilon_t \qquad (3.3)$$

Here, $OF_{b,t}$ is the block order flow at time t, (t may indicate trading hour or weekday), OF is the reference block order flow based on the first trading hour of (Monday) trading and ε_t is a zero mean error term. Table 3.7 reports the results of intraday and interday tests for common sample. The F test that there are no intraday variations in common block order flow is rejected at 1% level. Our results indicate that block trading activity significantly differs in the last two trading hours (at 10% and 1% level, respectively). The results in Panel B of table 3.7 allow us to identify block order flow patterns by day of the week. Overall, there is a strong evidence of interday variations in common block order flow: all of the average dummy variables are significantly different from zero.

When we distinguish between block purchases and block sales, some interesting results appear. Table 3.8 contains the results of the intraday and interday tests for the purchase block order flow.

First, we observe that there is weak significant evidence of variations across trading hours. We are not able to reject the hypothesis that the purchase block order flow is null at each trading hour, except for the last two trading hours (from 3:30 P.M. to 5:30 P.M.). Block trading activity for block purchases appears to be more intensive toward the closing of the trading day. The regression coefficient of these two hours is statistically significant at 5% level. The analysis of the interday tests (Panel B) reveals that the purchase block order flow varies across days of the week. In particular, it appears to be significantly concentrated on Wednesday and Thursday.

The sale block order flow exhibits a different pattern. The F-test that the sale block order flow is constant across all trading hours is rejected at 10% level (Table 3.9). An investigation into the individual trading hour coefficients suggests that the sale block order flow is concentrated in the last trading hour. The estimated coefficient is statistically significant at 1% level. For the other trading hours we cannot reject the hypothesis that the sale block order flow is the same within trading days. Interday tests (Panel B) show puzzling evidence. The result from the F-test indicate that there are weak interday variations in the sale block order flow (at 10% level). We find significant evidence for sale block order flow on Tuesday, Thursday and Friday.

In sum, block trading activity appears to be dominated by the effects of purchase block order flow. Both block purchases and block sales tend to be executed more toward the closing of the trading session, which suggests an intraday segmentation of block trading activity. At intraweek level the effects are different depending on block initiator.

3.5.3 Intraday and interday variations in the cost of execution

We employ a measure of cost of execution for block trades computed as the deviation in absolute value of the block price, $P_{b,t}$, from the market price immediately before the block trade execution, $P_{m,t-1}$. The distance of the block price from the market price at time $t-1$ can be viewed as an ex-post estimate of the cost of liquidity that the block trade would incur at the time of execution. The absolute price deviation can be expressed as:

$$ADev_{b,t} = |P_{b,t} - P_{m,t-1}| \tag{3.4}$$

$P_{m,t-1}$ is proxied by the midpoint quote at time $t-1$ before the execution of block trade. Both $P_{b,t}$ and $P_{m,t-1}$ are expressed in level. The examination of whether there are intraday and intraweek variations in the cost of executing block trades would provide insights into the role of discretionary liquidity traders. Theoretical models predict that these traders adjust their transactions to avoid times when execution costs are highest. From the results of the previous analysis on interday and intraday variations in block order flow, we may expect block order flow to be low during times when the cost of executing block trades is high.

We perform the nonparametric Kruskal-Wallis test to carry out our tests. Figure 3.11 exhibits the distribution of the cost of executing block trades. About 76% of observations range from values of 0 to 0.4. The distribution is characterized by large dispersion, as shown in Figure 3.12. Nonparametric tests are known to be more robust to the effect of outliers than the ANOVA based on the F test.[6] The Kruskal-Wallis test is equivalent to the ANOVA test and is approximated by a chi-square distribution under the null hypothesis.

Table 3.10 contains results for the common sample. The estimated cost of execution significantly differs from 11:30 A.M. to 12:30 P.M. and in the last two trading hours. Also the estimated cost of liquidity for block purchases shows similar intraday variations. Results from panel A of table 3.11 show that the estimated cost of executing block trades is significantly different from 11:30 A.M. to 12:30 P.M. and in the last trading hour (at 10% level). On a block trade by block trade basis, intraday segmentation in the cost of executing block purchases appears to be evident. Panel B of table 3.11 shows the results from intraweek tests. Surprisingly, we detect no significant differences across weekdays except for Wednesday and Friday.

The estimated cost of executing block sales exhibits a different pattern (Table 3.12). While we are not able to reject the hypothesis that the cost of execution is equal across all trading hours, we find that the cost of liquidity for block sales shows no significant variations except for the first trading hour (from 9:30 to 10:30 A.M.). Surprisingly, there is no significant evidence for interday effects.

In order to assess the robustness of these results, we first omit from our intraday and interday tests the stock with the largest number of block trades during the sample period. This stock is Olivetti and block trades of Olivetti company alone account for 25% over the total block trades executed.[7] In a second separate analysis we exclude outliers from our analysis. We investigate whether intraday and interday regularities above still persist after releasing block trades of this company and outliers.

Table 3.13 reports the results of the intraday and interday tests in the cost of executing block trades when omitting Olivetti stock from our analysis. Results from the intraday tests indicate that the cost of execution significantly differs within trading day, in particular, during the first, third and fifth trading hours on. Surprisingly, there is no significant evidence for intraweek effects (panel B, Table 3.13).

We then investigate whether there are differential effects depending on block initiator. There is evidence for intraday variations of the cost of executing block purchases (table 3.14). The cost of liquidity appears to significantly different during the third trading hour, and from 1:30 P.M. on. Again, we are not able to reject the null hypothesis that there are no intraweek variations for block purchases.

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[6]see Conover (1999).

[7]For a comparison, block trades for the second stock with the largest number of block trades executed account for 11% and for the third stock they account for 7% of the total sample.

The cost of executing block sales exhibits a completely different pattern. At intraday level, the cost of execution is significantly different during the first trading hour (Table 3.15), while there is no evidence for variations for other trading hours. Similarly to block purchases, we document no significant variations in the cost of execution throughout the weekdays.

We then investigate the time-dependent variations without outliers. To our purpose, we arbitrarily define as outliers observations with the cost of execution equal or larger than 1 in absolute value. Accordingly, outliers account for about 14% of the total sample.[8] From Table 3.16 we note that for the common sample there are significant intraday variations. The cost of execution appears to be significantly different during the third trading hour, and from 1:30 P.M. on until the closing of the trading session. At intraweek level, we document significant variations on the last two weekdays.

The pattern of the cost of executing block purchases is provided in Table 3.17. We find significant evidence for intraday variations during the third trading hour, and from the fifth trading hour (from 1:30 P.M.) on. At intraweek level the segmentation of liquidity appears to be significantly different on Friday.

Conversely, the first trading hour appears to be different for block sales (table 3.18). There is no evidence for other trading hours. We find no significant evidence for variations in the cost of execution at interday level. For a deeper investigation, we omit block trades for which the cost of execution is equal or larger than 0.1 in absolute value.[9] Results from table 3.19 indicate that there is no significant evidence for intraday variations in the cost of trading except for the last trading hour, while at intraweek level there is no significant evidence of different cost of liquidity.

In sum, block trades of Olivetti stock appear to drive intraweek variations of the cost of execution. After omitting them from the analysis, there is no significant evidence for interday effects. Overall, there is no differential interday variations for block sales, this is also the case when we exclude outliers from our tests. At intraday level, the finding that there are significant variations at different trading hours suggests the existence of some segmentation in the cost of liquidity for block sales. It is likely that for some block sales the cost of execution is different at different trading hours depending on the stock whose block trades are traded.

A different pattern of the cost of execution arises for block purchases. About 87% of block trades for Olivetti are block purchases. It may appear that they drive intraday and interday variations of the cost of executing all block purchases. After omitting block purchases of Olivetti we find more trading hours during which the cost of execution is significantly different from zero. This is also the case when we omit outliers from our analysis.

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[8]About 5% of these outliers refer to stocks different from Olivetti.

[9]Block sales for which the cost of execution is equal or larger than 0.1 in absolute value account for about 17% of all block sales.

3.6 Conclusions

The purpose of this paper is to investigate intraday and interday effects of block trading activity on the Italian Exchange. An exploratory analysis reveals that either block purchases or block sales show similar intraday and interday pattern. At intraday level, both block sales and block purchases are concentrated in the last two trading hours. Block purchases appear to be concentrated on Thursday and Friday, whereas block sales mostly execute on Friday.

Intraday and interday statistical tests provide more robust conclusions to the results of the exploratory analysis. Overall, they suggest that trading is concentrated in the last two trading hours. This behavior appears to reflect block trading activity driven by liquidity (e.g. portfolio rebalancing) rather than information motivations.

Results from the ANOVA tests show that the mean current impact is significant on Thursdays for both block purchases and block sales. Intraday tests suggest that purchase block order flow differs significantly within the trading day, and is concentrated during the last two trading hours. At intraweek level, the purchase block order flow appears to be concentrated on Wednesdays and Thursdays. Our results also reveal that there is intraday segmentation in the sale block order flow: block sales mostly execute in the last trading hour. Interday tests for block sales indicate significant variations on Tuesdays, Thursdays and Fridays. These findings suggest that changes across trading hours reflect liquidity- rather than information-driven activity.

Last, we examine intraday and interday variations of the cost of executing block trades. Results from nonparametric intraday and interday tests indicate that the cost of liquidity for block purchases varies within the trading day. The cost of trading appears to be significantly different from 11:30 to 12:30 P.M. and in the last two trading hours, while for block sales the cost of trading varies significantly in the last two trading hours. There is no significant evidence for intraweek effects for either block purchases or block sales.

Overall, our evidence indicates that intraday effects of block trading appear to predominate interday variations. This pattern is slightly different depending on the block initiator. Intraday segmentation in block order flow and the cost of execution appears to be significant for block sales. Intraday variations in the cost of execution for block purchases even increase after we omit block trades of the Olivetti stock.

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	N	Mean (Euro)	Tot (Euro)	Min (Euro)	Max (Euro)	% over tot
Mon	50.00	9284041.04	464202052.00	1545000.00	222834780.00	6.15
Tue	100.00	4180077.23	418007722.56	1507500.00	25842000.00	5.54
Wed	125.00	5228781.26	653597657.33	1500000.00	65000000.00	8.66
Thu	151.00	33196794.13	5012715914.12	518000.00	4177764351.00	66.42
Fri	131.00	7623075.42	998622879.92	1500750.00	174420000.00	13.23

Table 3.1: Summary statistics for block trades in value

This table reports the number, mean, total, minimum and maximum value and the percentage number of block trades in value over the sample period. The last column shows the relative weight in percentage terms of block trades in value on individual weekday over the total amount of block trades in value.

	N		Volume (ML shares)					Value volume (ML Euro)				
	Abs	%	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max
Monday	24	11	3.853	0.425	11.451	0.065	53.373	14.647	2.917	45.266	1.564	222.834
Tuesday	43	19	1.635	0.575	3.141	0.054	14.080	4.716	2.959	4.642	1.507	19.712
Wednesday	52	23	1.654	0.786	2.059	0.075	10.000	6.348	3.489	10.500	1.500	65.000
Thursday	66	29	17.512	0.742	123.021	0.050	1000.662	69.480	2.908	513.609	0.518	4177.764
Friday	43	19	1.582	0.560	2.565	0.060	11.018	5.012	2.892	7.893	1.526	47.566

Table 3.2: This table reports the summary statistics for buyer-initiated block trades through Monday to Friday from October to December 2001.

The percentage number of block purchases is computed over the total sample of block purchases. Volume is the number of shares expressed in terms of millions shares. For each block trade b the value volume is computed as the block price multiplied by the block volume and is expressed in millions of Euro.

	N		Volume (ML shares)					Value volume (ML Euro)				
	Abs	%	Mean	Median	Std	Min	Max	Mean	Median	Std	Min	Max
Monday	10	6	0.876	0.832	0.596	0.147	2.000	3.614	2.393	3.695	1.719	13.920
Tuesday	34	21	0.792	0.333	1.364	0.082	6.000	4.511	2.521	4.856	1.635	25.842
Wednesday	34	21	0.707	0.361	0.837	0.097	3.800	3.542	2.919	2.092	1.504	11.534
Thursday	40	25	0.629	0.300	0.757	0.077	3.800	3.836	2.832	2.226	1.039	10.458
Friday	41	26	0.859	0.420	1.027	0.057	5.000	5.247	3.182	6.927	1.500	37.200

Table 3.3: This table reports the summary statistics for seller-initiated block trades from Monday through Friday from October to December 2001.

The percentage number of block sales is computed over the total sample of block sales. Volume is the number of shares expressed in terms of millions shares. For each block trade b the value volume is computed as the block price multiplied by the block volume and is expressed in millions of Euro.

Regression coefficients	Mon	Tue	Wed	Thu	Fri	$\overline{R}^2$	F
All sample	-0.008	0.008	0.004	0.018	0.004	0.041	5.146**
	(-1.758)	(1.414)	(0.738)	(3.329)**	(0.693)		
Purchases	-0.077	0.007	0.004	0.014	0.009	0.006	1.391
	(-1.324)	(0.969)	(0.552)	(2.013)*	(1.181)		
Sales	-0.008	0.008	0.003	0.024	-0.002	0.127	6.726**
	(-1.049)	(0.946)	(0.401)	(2.809)**	(-0.240)		

Table 3.4: Weekday effects: cross-sectional variations in current impacts

This table reports the coefficients from regression (3.2). T-statistics for tests of the null hypothesis that parameters estimates for each weekday are zero are reported in parenthesis. The F-statistic of whether the Tuesday through Friday means are equal (F_4), are obtained from analysis of variance regressions on the weekday dummies. * denotes significance at $\leq 5\%$ level, ** denotes significance at $\leq 1\%$.

Regression coefficients							
	Mon	Tue	Wed	Thu	Fri	$\overline{R}^2$	F
All sample	-0.000	0.150	0.041	0.228	0.085	0.022	3.151**
	(-1.204)	(1.837)	(0.489)	(2.621)**	(1.018)		
Purchases	0.000	0.161	0.016	0.150	0.142	0.009	1.489
	(-0.662)	(1.618)	(0.157)	(1.392)	(1.430)		
Sales	-0.000	0.167	0.104	0.379	0.056	0.067	6.820**
	(-1.227)	(1.168)	(0.726)	(2.550)**	(0.373)		

Table 3.5: Weekday effects: cross-sectional variations in current impacts (when assuming that α tends to zero and β tends to one).

This table reports the coefficients from regression (3.2) when assuming that the parameters of the market model, α and β, tend to zero and to one, respectively. T-statistics for tests of the null hypothesis that parameters estimates for each weekday are zero are reported in parenthesis. The F-statistic of whether the Tuesday through Friday means are equal (F_4), are obtained from analysis of variance regressions on the weekday dummies. * denotes significance at $\leq$ 5% level, ** denotes significance at $\leq$ 1%.

Regression coefficients							
	Mon	Tue	Wed	Thu	Fri	$\overline{R}^2$	F
All sample	-0.000	0.133	0.067	0.293	0.071	0.040	4.963**
	(-1.227)	(1.596)	(0.782)	(3.270)**	(0.835)		
Purchases	0.000	0.119	0.062	0.218	0.130	0.006	1.320
	(-1.102)	(1.134)	(0.567)	(1.915)*	(1.241)		
Sales	-0.000	0.144	0.068	0.414	-0.018	0.124	6.594**
	(-0.530)	(1.043)	(0.491)	(2.876)**	(-0.122)		

Table 3.6: Weekday effects: cross-sectional variations in current impacts (α and β estimated over the sample period).

This table reports the coefficients from regression (3.2) when estimating α and β over the sample period. T-statistics for tests of the null hypothesis that parameters estimates for each weekday are zero are reported in parenthesis. The F-statistic of whether the Tuesday through Friday means are equal (F_4), are obtained from analysis of variance regressions on the weekday dummies. * denotes significance at $\leq 5\%$ level, ** denotes significance at $\leq 1\%$.

	Coefficient	Statistic test	p-value
A. Intraday effect			
Across all trading hours(F test)		2.682	0.016
γ_2 (10:30)	0.000	0.000	1.000
γ_3 (11:30)	0.052	0.374	0.709
γ_4 (12:30)	0.104	0.749	0.456
γ_5 (13:30)	-0.009	-0.062	0.950
γ_6 (14:30)	0.191	1.373	0.174
γ_7 (15:30)	0.251	1.810	0.074
γ_8 (16:30)	0.451	3.245	0.002
B. Interday effect			
Across all weekdays(F test)		4.390	0.003
γ_2 (Tue)	0.314	2.392	0.019
γ_3 (Wed)	0.373	2.840	0.006
γ_4 (Thu)	0.531	4.036	0.000
γ_5 (Fri)	0.367	2.790	0.007

Table 3.7: Common block order flow: intraday and intraweek effects

This table reports the results of intraday and interday tests from ANOVA regressions on trading hour (weekday) dummies for common block order flow. Intraday (intraweek) tests are based on the F test obtained from analysis of variance regression on dummies excluding dummy on the first hour of (Monday) trading under the null that there are no intraday (interday) variations in block order flow. T-student tests are performed under the null that each regression coefficient γ_t is equal to zero.

	Coefficient	Statistic test	p-value
A. Intraday effect			
Across all trading hours(F test)		2.194	0.061
γ_2 (10:30)	-0.079	-0.410	0.685
γ_3 (11:30)	-0.126	-0.656	0.517
γ_4 (12:30)	0.079	0.410	0.685
γ_5 (13:30)	0.016	0.082	0.935
γ_6 (14:30)	0.205	1.066	0.294
γ_7 (15:30)	0.394	2.050	0.049
γ_8 (16:30)	0.394	2.050	0.049
B. Interday effect			
Across all weekdays(F test)		2.606	0.052
γ_2 (Tue)	0.286	1.524	0.137
γ_3 (Wed)	0.417	2.222	0.033
γ_4 (Thu)	0.584	3.111	0.004
γ_5 (Fri)	0.286	1.254	0.137

Table 3.8: Purchase block order flow: intraday and intraweek effects

This table reports the results of intraday and interday tests for purchase block order flow. Intraday (intraweek) tests are based on the F test obtained from analysis of variance regression on dummies excluding dummy on the first hour of (Monday) trading under the null that there are no intraday (interday) variations in block order flow. T-student tests are performed under the null that each regression coefficient γ_t is equal to zero.

	Coefficient	Statistic test	p-value
A. Intraday effect			
Across all trading hours		1.931	0.097
γ_2 (10:30)	0.105	0.536	0.596
γ_3 (11:30)	0.294	1.501	0.143
γ_4 (12:30)	0.147	0.750	0.458
γ_5 (13:30)	-0.042	-0.214	0.832
γ_6 (14:30)	0.189	0.965	0.342
γ_7 (15:30)	0.084	0.429	0.671
γ_8 (16:30)	0.568	2.895	0.007
B. Interday effect			
Across all weekdays		2.427	0.066
γ_2 (Tue)	0.381	2.016	0.052
γ_3 (Wed)	0.350	1.848	0.073
γ_4 (Thu)	0.509	2.688	0.011
γ_5 (Fri)	0.509	2.688	0.011

Table 3.9: Sale block order flow: intraday and intraweek effects

This table reports the results of intraday and interday tests for sale block order flow. Intraday (intraweek) tests are based on the F test obtained from analysis of variance regression on dummies excluding dummy on the first hour of (Monday) trading under the null that there are no intraday (interday) variations in block order flow. T-student tests are performed under the null that each regression coefficient γ_t is equal to zero.

	Kruskal-Wallis test	p-value
A. Intraday effect		
Across all trading hours	10.173	0.038
1 trading hour	0.163	0.687
2 trading hour	0.755	0.385
3 trading hour	11.059	0.001
4 trading hour	1.444	0.230
5 trading hour	0.109	0.741
6 trading hour	2.313	0.128
7 trading hour	2.892	0.089
8 trading hour	5.578	0.018
B. Interday effect		
Across all weekdays	10.173	0.038
Monday	0.025	0.875
Tuesday	0.843	0.358
Wednesday	2.499	0.114
Thursday	3.288	0.070
Friday	6.627	0.010

Table 3.10: The cost of execution for common sample: intraday and intraweek effects

This table shows the results of the nonparametric Kruskal-Wallis tests for common sample. The nonparametric Kruskal-Wallis is under the null that 1) the absolute price deviation is equal across all trading hours (weekdays); 2) any trading hour (weekday) is equal to other trading hours (weekdays). The null for the Kruskal-Wallis test is computed under a chi-square distribution.

	Kruskal-Wallis test	p-value
A. Intraday effect		
Across all trading hours	14.119	0.049
1 trading hour	0.214	0.643
2 trading hour	0.160	0.689
3 trading hour	7.978	0.005
4 trading hour	0.580	0.446
5 trading hour	0.173	0.677
6 trading hour	2.574	0.109
7 trading hour	0.678	0.410
8 trading hour	3.619	0.057
B. Interday effect		
Across all weekdays	9.875	0.043
Monday	0.019	0.889
Tuesday	0.667	0.414
Wednesday	4.456	0.035
Thursday	1.996	0.318
Friday	6.438	0.011

Table 3.11: The cost of execution for block purchases: intraday and intraweek effects

This table shows the results of the nonparametric Kruskal-Wallis tests for block purchases sample. The nonparametric Kruskal-Wallis is under the null that 1) the absolute price deviation is equal across all trading hours (weekdays); 2) any trading hour (weekday) is equal to other trading hours (weekdays). The null for the Kruskal-Wallis test is computed under a chi-square distribution.

	Kruskal-Wallis test	p-value
A. Intraday effect		
Across all trading hours	9.750	0.203
1 trading hour	4.885	0.027
2 trading hour	0.376	0.540
3 trading hour	0.808	0.369
4 trading hour	2.439	0.118
5 trading hour	0.013	0.910
6 trading hour	0.083	0.773
7 trading hour	0.009	0.925
8 trading hour	2.614	0.106
B. Interday effect		
Across all weekdays	2.659	0.616
Monday	0.660	0.417
Tuesday	0.377	0.539
Wednesday	0.024	0.878
Thursday	2.226	0.136
Friday	0.112	0.738

Table 3.12: The cost of execution for block sales: intraday and intraweek effects

This table shows the results of the nonparametric Kruskal-Wallis tests for block sales. The nonparametric Kruskal-Wallis is under the null that 1) the absolute price deviation is equal across all trading hours (weekdays); 2) any trading hour (weekday) is equal to other trading hours (weekdays). The null for the Kruskal-Wallis test is computed under a chi-square distribution.

	Kruskal-Wallis test	p-value
A. Intraday effect		
Across all trading hours	28.435	0.000
1 trading hour	2.840	0.092
2 trading hour	0.110	0.740
3 trading hour	8.520	0.004
4 trading hour	0.272	0.602
5 trading hour	2.726	0.099
6 trading hour	3.167	0.075
7 trading hour	7.443	0.006
8 trading hour	8.398	0.004
B. Interday effect		
Across all weekdays	1.713	0.788
Monday	0.693	0.405
Tuesday	0.096	0.757
Wednesday	0.064	0.800
Thursday	0.579	0.447
Friday	0.681	0.409

Table 3.13: The cost of execution for common sample: intraday and intraweek effects - Olivetti stock excluded

This table shows the results of the nonparametric Kruskal-Wallis tests for common sample. The nonparametric Kruskal-Wallis is under the null that 1) the absolute price deviation is equal across all trading hours (weekdays); 2) any trading hour (weekday) is equal to other trading hours (weekdays). The null for the Kruskal-Wallis test is computed under a chi-square distribution.

	Kruskal-Wallis test	p-value
A. Intraday effect		
Across all trading hours	29.787	0.000
1 trading hour	0.037	0.847
2 trading hour	0.367	0.544
3 trading hour	8.402	0.004
4 trading hour	0.168	0.682
5 trading hour	6.622	0.010
6 trading hour	5.086	0.024
7 trading hour	7.541	0.006
8 trading hour	6.735	0.009
B. Interday effect		
Across all weekdays	4.216	0.378
Monday	2.360	0.125
Tuesday	0.476	0.490
Wednesday	0.047	0.828
Thursday	0.078	0.780
Friday	2.085	0.149

Table 3.14: The cost of execution for block purchases: intraday and intraweek effects - Olivetti stock excluded

This table shows the results of the nonparametric Kruskal-Wallis tests for block purchases. The nonparametric Kruskal-Wallis is under the null that 1) the absolute price deviation is equal across all trading hours (weekdays); 2) any trading hour (weekday) is equal to other trading hours (weekdays). The null for the Kruskal-Wallis test is computed under a chi-square distribution.

	Kruskal-Wallis test	p-value
A. Intraday effect		
Across all trading hours	11.911	0.104
1 trading hour	6.961	0.008
2 trading hour	0.013	0.908
3 trading hour	2.134	0.144
4 trading hour	1.408	0.235
5 trading hour	0.526	0.468
6 trading hour	0.019	0.890
7 trading hour	0.362	0.547
8 trading hour	2.203	0.138
B. Interday effect		
Across all weekdays	3.644	0.456
Monday	0.730	0.393
Tuesday	1.841	0.175
Wednesday	0.000	0.988
Thursday	1.974	0.160
Friday	0.124	0.725

Table 3.15: The cost of execution for block sales: intraday and intraweek effects - Olivetti stock excluded

This table shows the results of the nonparametric Kruskal-Wallis tests for common sample. The nonparametric Kruskal-Wallis is under the null that 1) the absolute price deviation is equal across all trading hours (weekdays); 2) any trading hour (weekday) is equal to other trading hours (weekdays). The null for the Kruskal-Wallis test is computed under a chi-square distribution.

	Kruskal-Wallis test	p-value
A. Intraday effect		
Across all trading hours	25.677	0.001
1 trading hour	0.600	0.439
2 trading hour	0.118	0.731
3 trading hour	7.549	0.006
4 trading hour	0.350	0.554
5 trading hour	3.178	0.075
6 trading hour	3.661	0.056
7 trading hour	5.048	0.025
8 trading hour	9.908	0.002
B. Interday effect		
Across all weekdays	6.059	0.195
Monday	0.414	0.520
Tuesday	0.046	0.831
Wednesday	0.007	0.934
Thursday	2.973	0.085
Friday	4.514	0.034

Table 3.16: The cost of execution for common sample: intraday and intraweek effects - outliers excluded

This table shows the results of the nonparametric Kruskal-Wallis tests for common sample. The nonparametric Kruskal-Wallis is under the null that 1) the absolute price deviation is equal across all trading hours (weekdays); 2) any trading hour (weekday) is equal to other trading hours (weekdays). The null for the Kruskal-Wallis test is computed under a chi-square distribution. Outliers are observations that with cost of execution equal or larger than 1 in absolute value.

	Kruskal-Wallis test	p-value
A. Intraday effect		
Across all trading hours	30.406	0.000
1 trading hour	0.533	0.465
2 trading hour	0.011	0.918
3 trading hour	10.490	0.001
4 trading hour	0.329	0.566
5 trading hour	4.647	0.031
6 trading hour	5.119	0.024
7 trading hour	5.396	0.020
8 trading hour	8.859	0.003
B. Interday effect		
Across all weekdays	7.373	0.117
Monday	1.351	0.245
Tuesday	0.056	0.813
Wednesday	0.112	0.738
Thursday	0.972	0.324
Friday	6.643	0.010

Table 3.17: The cost of trading for block purchases: intraday and intraweek effects - outliers excluded

This table shows the results of the nonparametric Kruskal-Wallis tests for block purchases. The nonparametric Kruskal-Wallis is under the null that 1) the absolute price deviation is equal across all trading hours (weekdays); 2) any trading hour (weekday) is equal to other trading hours (weekdays). The null for the Kruskal-Wallis test is computed under a chi-square distribution. Outliers are observations that with cost of execution equal or larger than 1 in absolute value.

	Kruskal-Wallis test	p-value
A. Intraday effect		
Across all trading hours	9.181	0.240
1 trading hour	4.776	0.029
2 trading hour	0.325	0.569
3 trading hour	0.713	0.398
4 trading hour	2.633	0.105
5 trading hour	0.006	0.938
6 trading hour	0.056	0.813
7 trading hour	0.020	0.888
8 trading hour	1.955	0.162
B. Interday effect		
Across all weekdays	3.109	0.540
Monday	0.612	0.434
Tuesday	0.799	0.371
Wednesday	0.007	0.931
Thursday	2.514	0.113
Friday	0.065	0.799

Table 3.18: The cost of execution for block sales: intraday and intraweek effects - outliers excluded

This table shows the results of the nonparametric Kruskal-Wallis tests for block sales. The nonparametric Kruskal-Wallis is under the null that 1) the absolute price deviation is equal across all trading hours (weekdays); 2) any trading hour (weekday) is equal to other trading hours (weekdays). The null for the Kruskal-Wallis test is computed under a chi-square distribution. Outliers are observations that with cost of execution equal or larger than 1 in absolute value.

	Kruskal-Wallis test	p-value
A. Intraday effect		
Across all trading hours	9.233	0.236
1 trading hour	2.184	0.139
2 trading hour	1.480	2.224
3 trading hour	0.023	0.881
4 trading hour	1.227	0.268
5 trading hour	0.162	0.688
6 trading hour	1.503	0.220
7 trading hour	0.156	0.693
8 trading hour	4.211	0.040
B. Interday effect		
Across all weekdays	0.951	0.917
Monday	0.007	0.933
Tuesday	0.060	0.807
Wednesday	0.022	0.882
Thursday	0.836	0.361
Friday	0.336	0.562

Table 3.19: The cost of trading for block sales: intraday and intraweek effects - outliers excluded

This table shows the results of the nonparametric Kruskal-Wallis tests for block sales. The nonparametric Kruskal-Wallis is under the null that 1) the absolute price deviation is equal across all trading hours (weekdays); 2) any trading hour (weekday) is equal to other trading hours (weekdays). The null for the Kruskal-Wallis test is computed under a chi-square distribution. Outliers are observations that show the cost of trading equal or larger than 0.1 in absolute value.

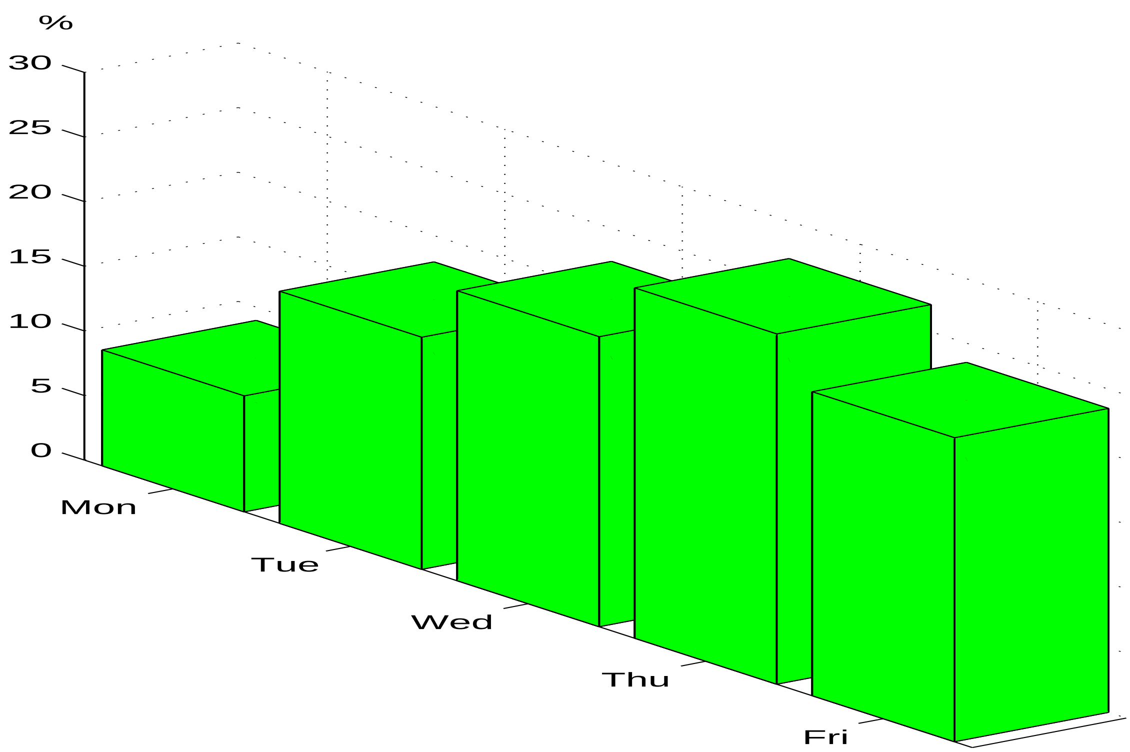

Figure 3.1: Distribution of the number of block trades by day of the week and trading sessions from October through December 2001.

This figure shows the distribution of the block order flow by day of the week and trading session (off and normal trading hours) from October to December 2001. The figures are expressed as percentage of the total block order flow over the sample period.

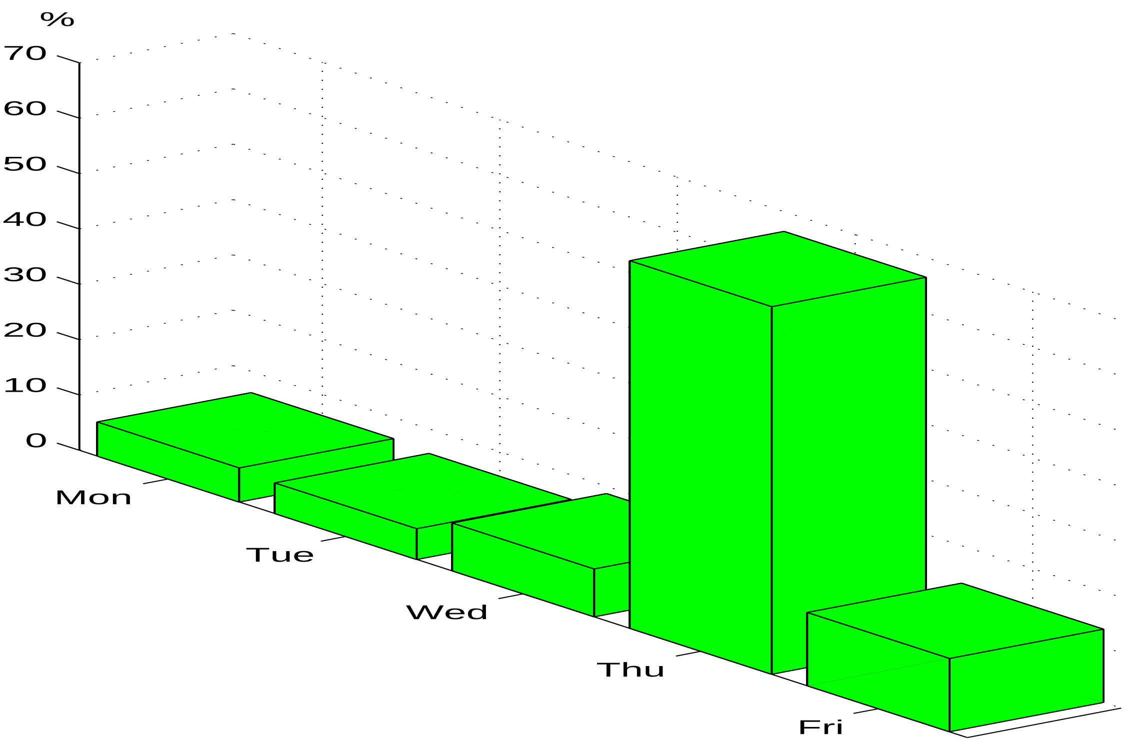

Figure 3.2: Distribution of percentage block trades in value by day of the week and trading sessions from October through December 2001.

This figure shows the distribution of the total amount of block trades in value by day of the week and trading session (off and normal trading hours) from October to December 2001. The figures are expressed as percentage of the total block trade in value over the sample period.

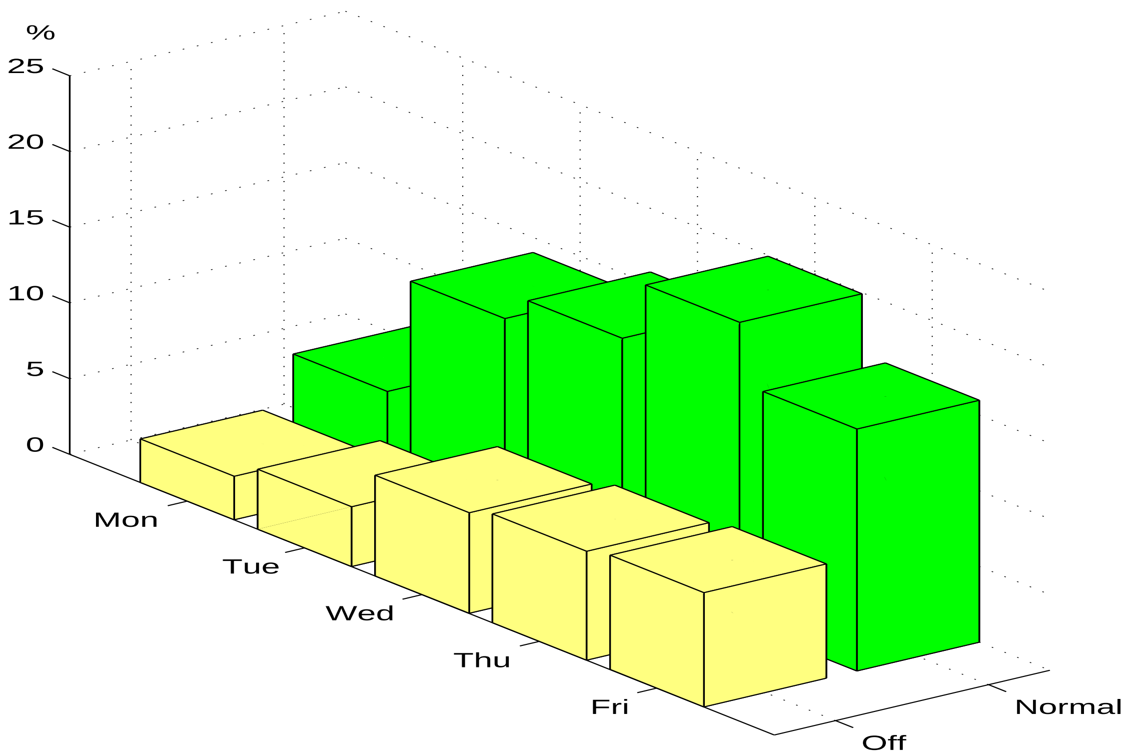

Figure 3.3: Distribution of the number of block trades by day of the week and trading sessions from October through December 2001.

This figure shows the distribution of the block order flow by day of the week and trading session (off and normal trading hours) from October to December 2001. The figures are expressed as percentage of the total block order flow over the sample period.

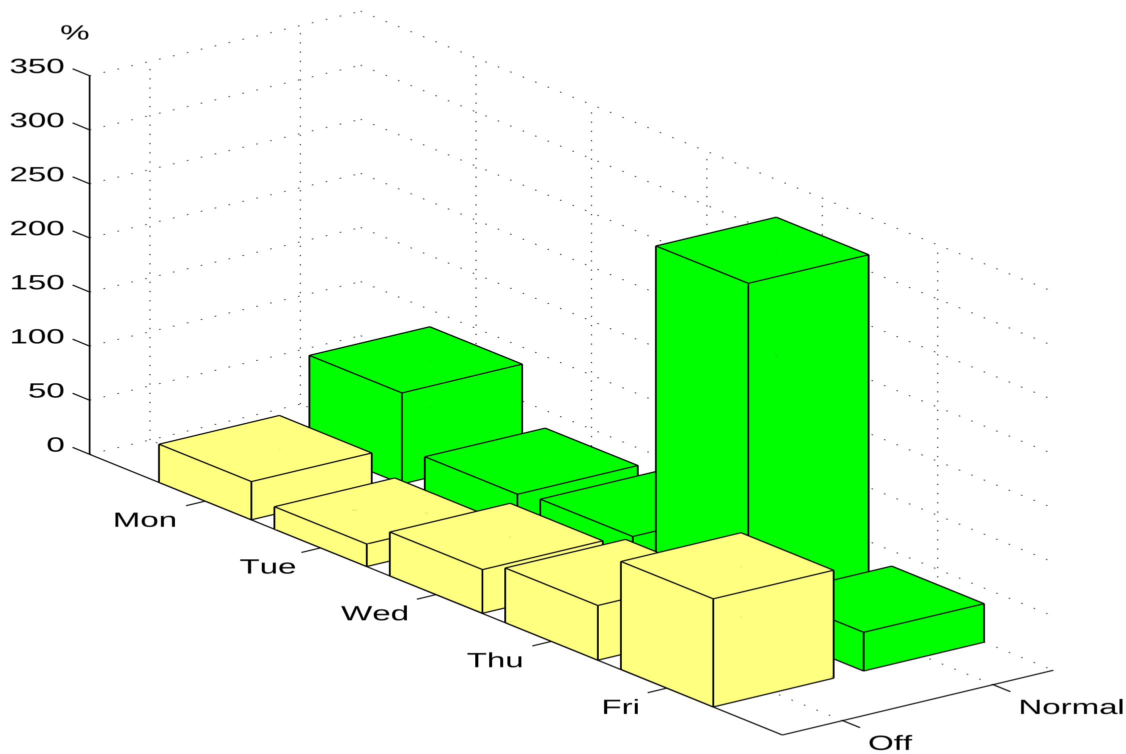

Figure 3.4: Distribution of the total amount of block trades in value by day of the week and trading sessions from October through December 2001.

This figure shows the distribution of the total amount of block trades in value by day of the week and trading sessions (off and normal trading hours) from October to December 2001. The figures are expressed as percentage over the gran total amount of block trades in value over the sample period.

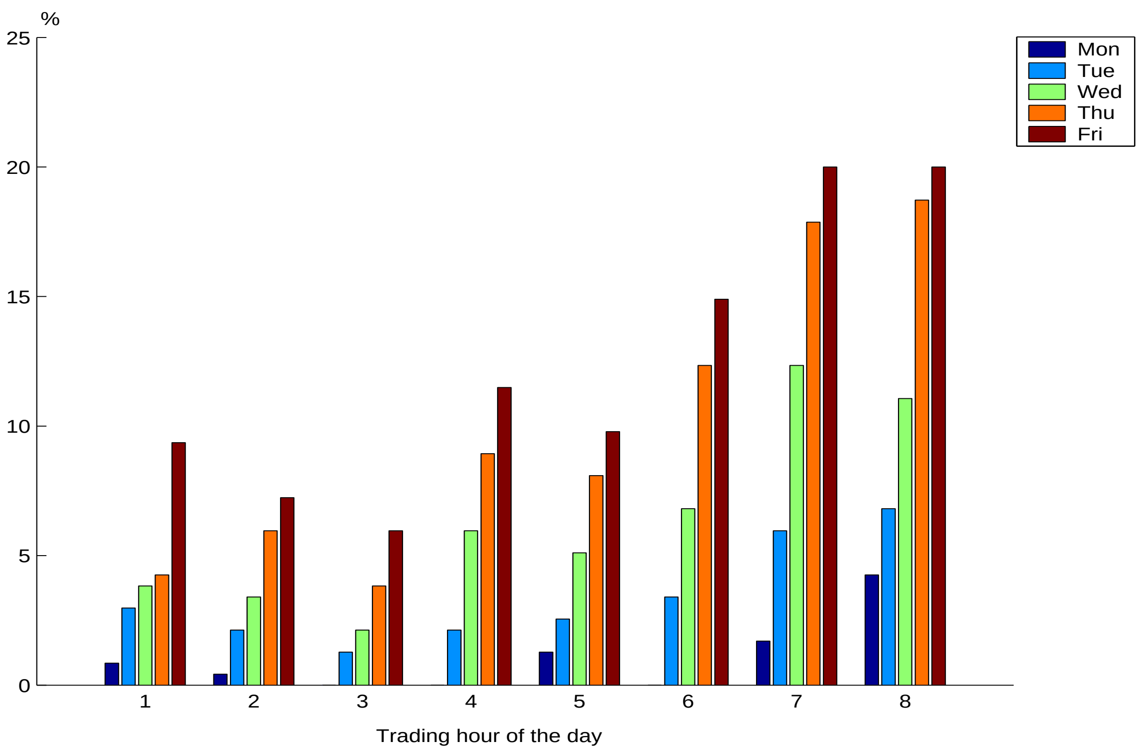

Figure 3.5: Distribution of the number of block purchases by trading hour of the weekday from Monday through Friday from October through December 2001.

This figure shows the distribution of the number of block purchases by trading hour for each day of the week from October to December 2001. The figures are expressed as percentage of the total number of block purchases over the sample period. The daily trading session is from 9:30 A.M. to 5:30 P.M.

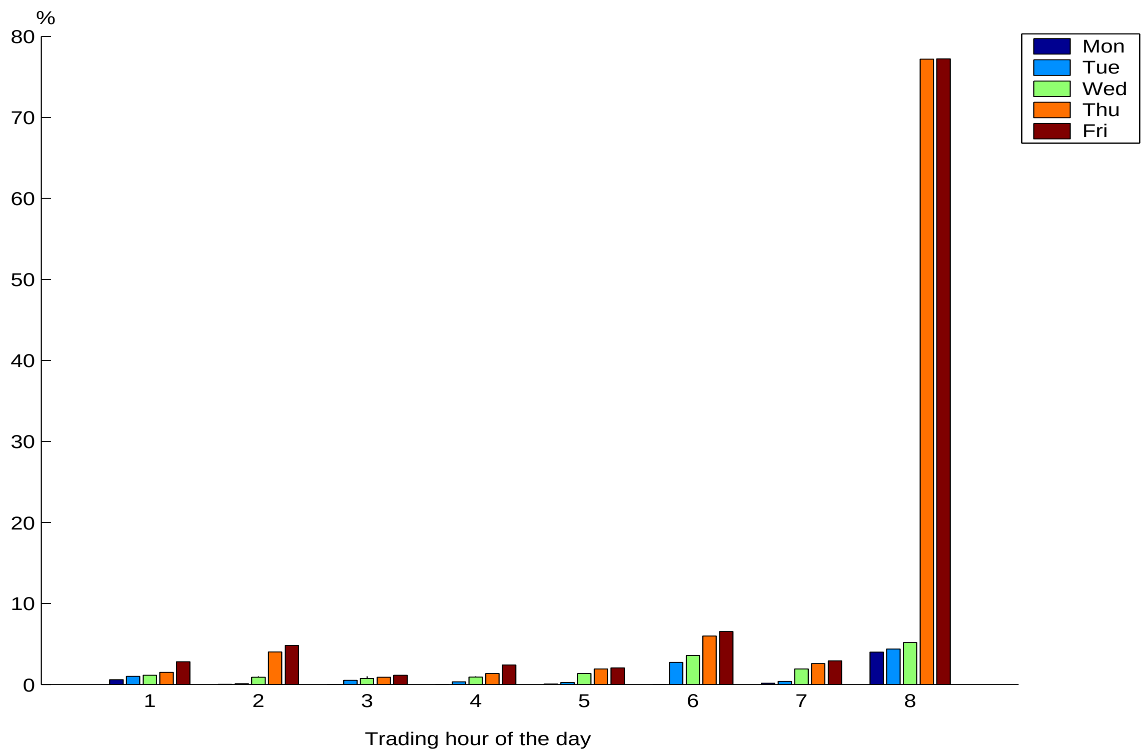

Figure 3.6: Distribution of the total block trade in share for block purchases by trading hour of the weekday from October through December 2001.

This figure shows the distribution of the average hourly block volume in share for block purchases by trading hour for each day of the week from October to December 2001. The daily trading session is from 9:30 A.M. to 5:30 P.M.

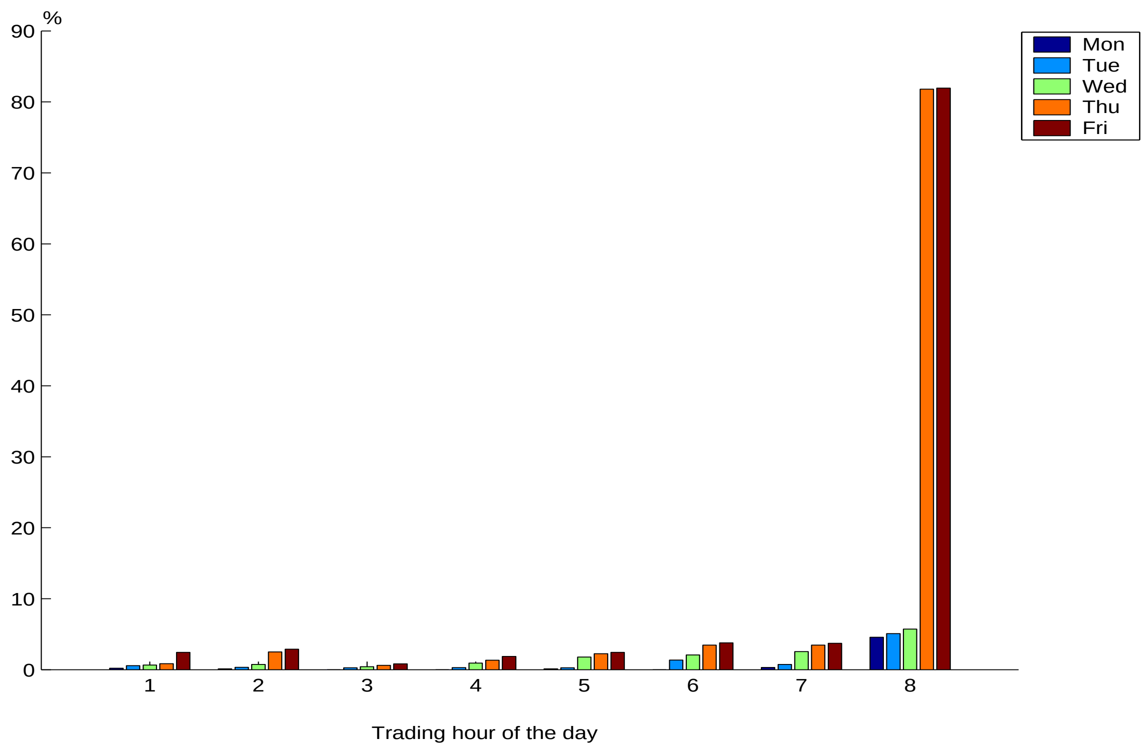

Figure 3.7: Distribution of the total block trade in value for block purchases by trading hour of the weekday from October through December 2001.

This figure shows the distribution of the total block trade in value for block purchases by trading hour for each day of the week from October to December 2001. The daily trading session is from 9:30 A.M. to 5:30 P.M.

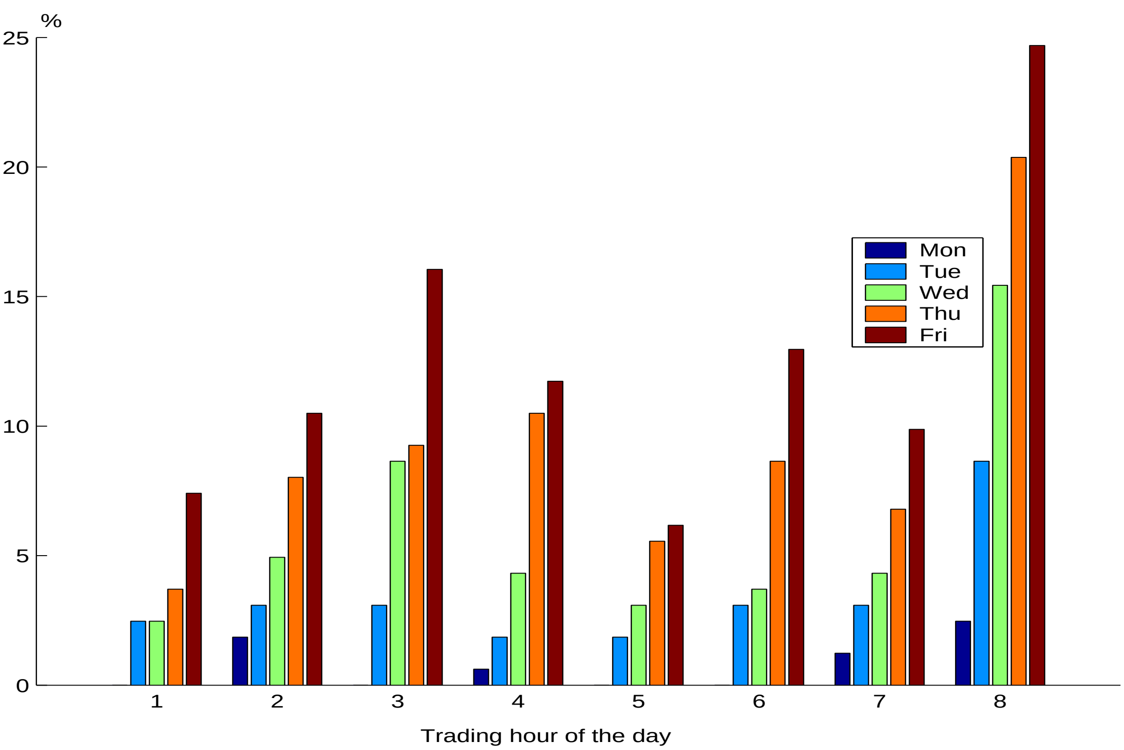

Figure 3.8: Distribution of the number of block sales by trading hour of the weekday from October through December 2001.

This figure shows the distribution of the number of block sales by trading hour for each day of the week from October to December 2001. The figures are expressed as percentage of the total number of block trades over the sample period. The daily trading session is from 9:30 A.M. to 5:30 P.M.

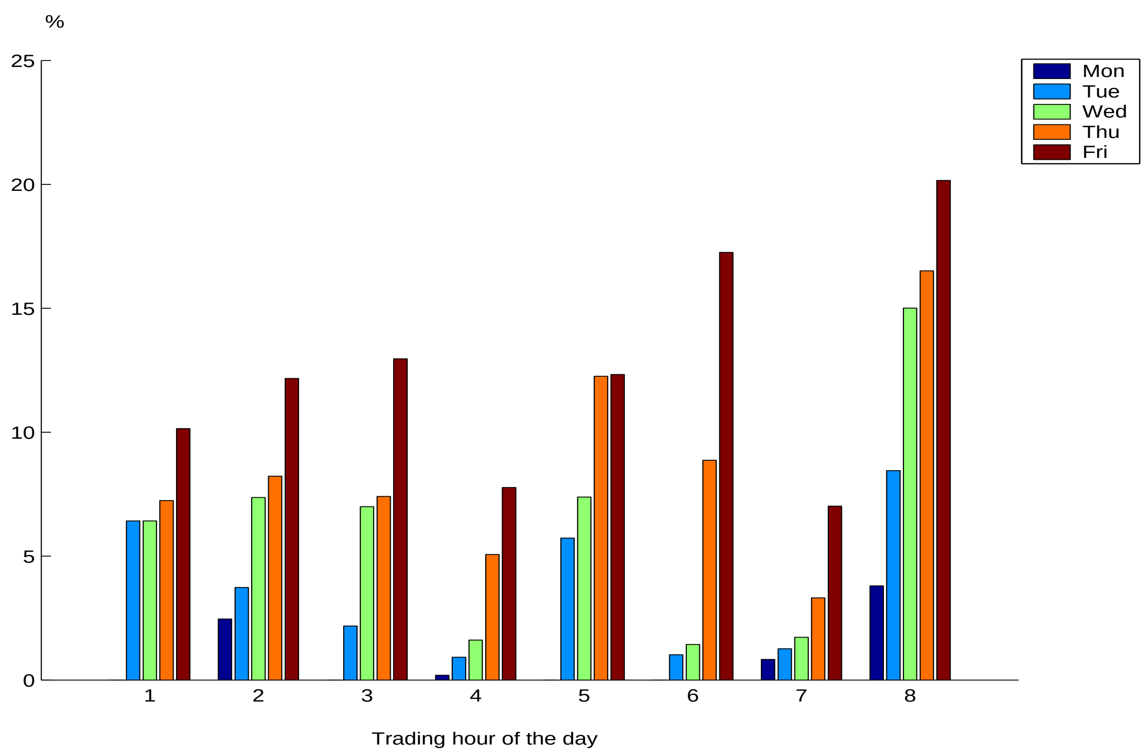

Figure 3.9: Distribution of the average hourly block volume in share for block sales by trading hour of the weekday from October through December 2001.

This figure shows the distribution of the total block trade in share for block sales by trading hour for each day of the week from October to December 2001. The daily trading session is from 9:30 A.M. to 5:30 P.M.

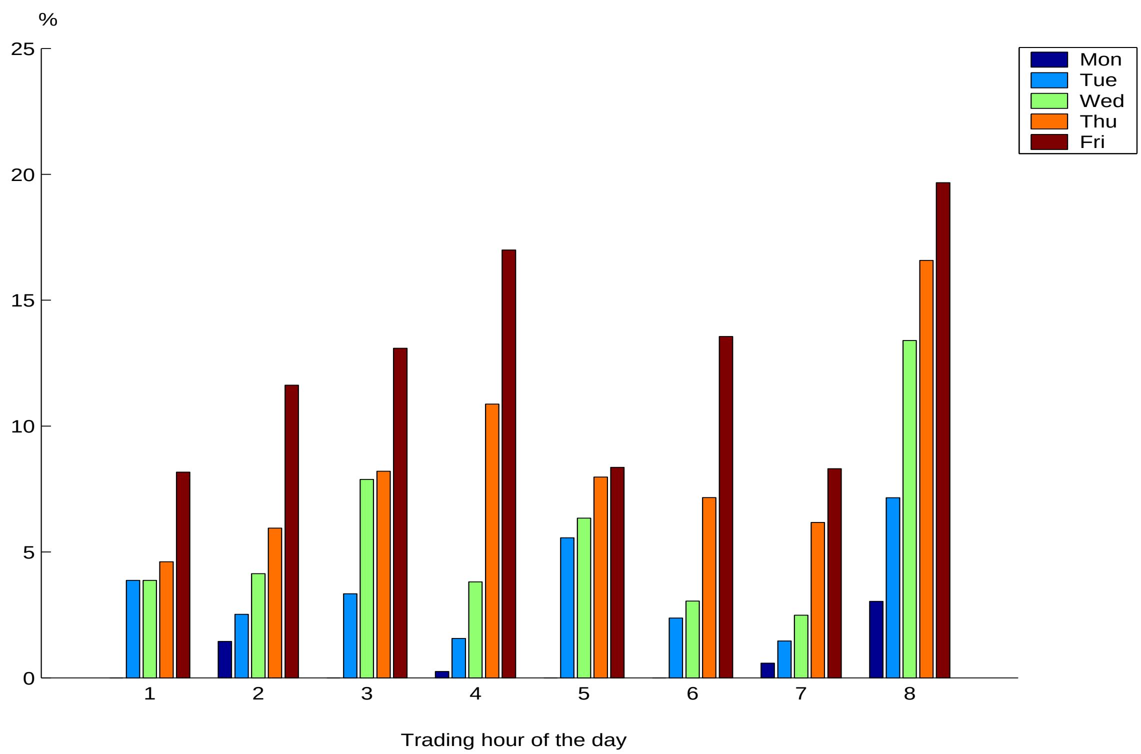

Figure 3.10: Distribution of the total block trade in value for block sales by trading hour of the weekday from October through December 2001.

This figure shows the distribution of the total block trade in value for block sales by trading hour for each day of the week from October to December 2001. The daily trading session is from 9:30 A.M. to 5:30 P.M.

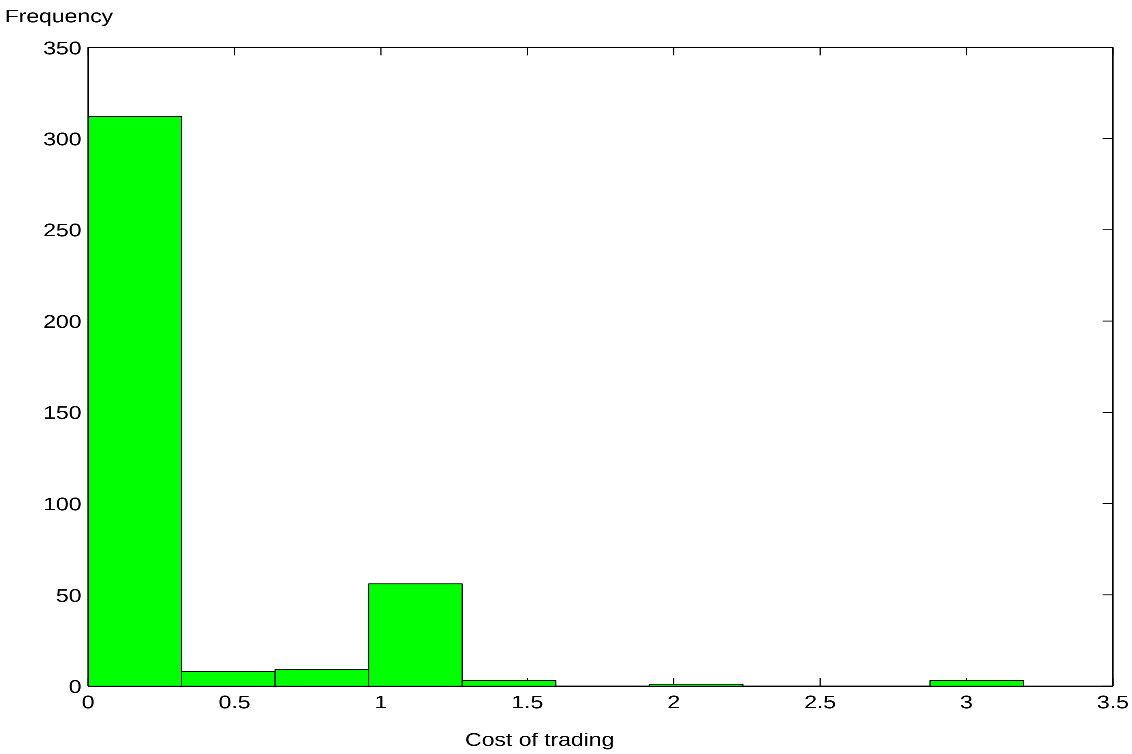

Figure 3.11: Distribution of the cost of execution for common sample from October through December 2001.

This figure shows the frequency distribution of the cost of execution for common sample of block trades from October to December 2001. The daily trading session is from 9:30 A.M. to 5:30 P.M. The cost of execution is the deviation, in absolute value, of the block price at time t from the market price at time $t-1$.

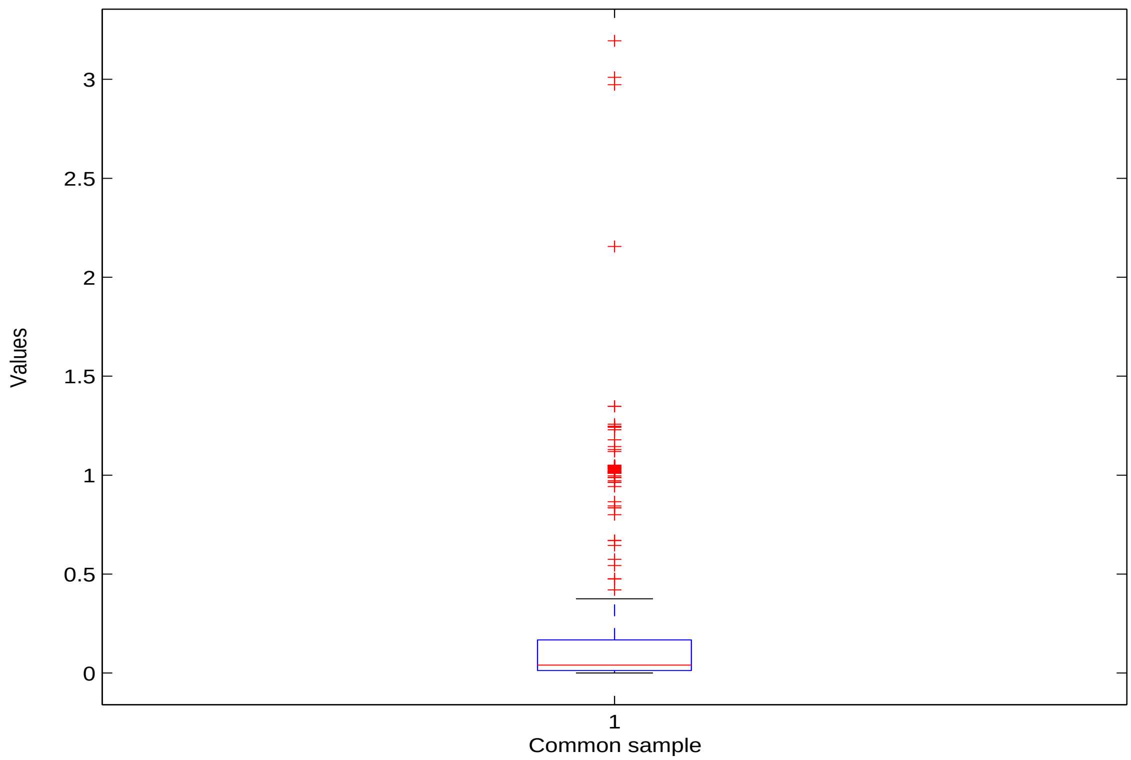

Figure 3.12: Boxplot for the cost of execution for common sample from October through December 2001.

This figure shows the boxplot of the cost of execution for common sample from October to December 2001. The daily trading session is from 9:30 A.M. to 5:30 P.M. The cost of execution is the deviation, in absolute value, of the block price at time t from the market price at time $t-1$.

Chapter 4

Conclusions

This study provides empirical insights into intraday dynamics of price and liquidity around large block trades on the Italian Exchange. We now review the main results presented in each of the three Chapters.

4.1 The microstructure of block trading mechanisms in European equity markets: a survey

The first chapter is a survey on the main design features of the major trading systems for large-block transactions in Europe. We first discussed why it is important for large-block transactions to be handled in a separate trading venue, then outlined the main trading rules for block trading activity enforced on each European stock exchange. At the end, we discussed about the main institutional similarities and dissimilarities of these trading mechanisms.

The steady growth of institutional trading is the main factor that calls for an *ad hoc* trading system for the handling of large-block trades. In recent years, this trend has become sharper in Continental European equity markets than in the United States or United Kingdom. On one side, the needs for retirement benefits of an aging population, the unsubstainability of the model of welfare state in most European countries and on another side, the major scope for expansion of these markets can be considered the main driving forces of the structural changes of the European equity markets. This trend is also more noticeable as the European financial integration get stronger, and calls for the need of common rules across European stock exchanges.

The major European trading systems for large-block transactions share some basic institutional design features. However, institutional differences predominate, and elements of institutional dissimilarities even coexist with institutional similarities. Block transactions on the major European equity markets are arranged in a trading mechanism separated from the regulated market, although the way this is implemented varies from stock exchange to stock exchange. On some exchanges block transactions are executed in the form of prearranged agreements, on other exchanges (e.g. the Italian Exchange) block trades are required to meet no particular trading procedure to be executed. Common institutional design features also include anonymity and pre-trade transparency. Anonymity refers to information about the identity of traders submitting orders. Pre-trade transparency concerns the availability of information about the order flow impending in the market and the prices at which incoming orders are likely to be executed. The concern of regulators is to preserve these conditions regardless of the order routing system (whether intermediated or nonintermediated).

The main institutional differences concern the design features of the enforcement of interaction rules, the upstairs routing systems and post-trade transparency. The issue of the enforcement of interaction rules appears somewhat controversial. There are dissimilarities in the interaction rules even on exchanges which enforce them. These differences mainly consist in the varying degree of restrictiveness of interaction rules. A cross-sectional variation of the rule is allowed depending on the order size and liquidity of the security, although the reference price at which the block price is enforced varies considerably across these exchanges. This difference has of course consistent effects on trading costs. A further aspect of this issue regards the lack of linkage between upstairs and downstairs markets on markets which enforce no interaction. These exchanges actually rely on block intermediaries (as block broker and/or block dealer) to informally provide this interaction through the best execution principle.

European exchanges differ also in the way block trades are executed. Although most trading mechanisms are still intermediation-based, advances in trading automation and telecommunication have made it easy for institutional investors to bypass human intermediation. The ongoing trend is an increasing disintermediation of block trading activity. Large-block trades are executed via an electronic limit order book,like in the regulated market, with considerable cost savings. While disintermediation raises the question of the future role of block intermediaries as source of wholesale liquidity, it will undoubtedly give further comparative advantages to exchanges which make it a built-in design feature.

Post-trade transparency is another major institutional difference. It refers to the availability of data about the last executed trades, and depends on the publication rules of the exchange. While there are converging rules for tight reporting deadlines and trade details, the post-trade information differs in the time of publication to the market. Typically, exchanges allow for a delay in the time of publication of block trades; delays are most likely in markets where dealers take position to facilitate investor business.

The final picture emerging from this survey is a broad fragmentation of trading rules for large-block trades on the major European stock exchanges. This fragmentation has been viewed by many as the main failure of attempts that have been made for the creation of a single European stock exchange. In particular, the differences of trading systems between the London Stock Exchange and continental European equity markets appear to be hard to reconcile. The major effect of dissimilarities on the trading rules is the regulatory arbitrage which has been observed between London and the Paris

Bourse. However, institutional fragmentation fosters regulatory competition and innovation with consistent benefits for overall liquidity.

4.2 Price and liquidity effects around large-block trades on the Italian Exchange

Chapter 2 is an empirical study of the intraday effects on market price and liquidity of large-block transactions. We focus on the Italian Exchange because of the lack of interaction between the upstairs and downstairs markets. In addition, Exchange rules allow for a sixty-minute delay for the publication of block trades. Following the empirical literature, we first examined the impact of block trades on the market price, then expanded our analysis to the effects on market liquidity. We carried out the analysis on the dynamics on quoted liquidity both in clock and transaction event time to get robust conclusions from our tests. In the end, we examined whether block trading activity gives rise to commonality in order flow and returns. This investigation allowed us to better understand how effectively the linkage between the upstairs and the downstairs markets takes place in a trading system which provides no interaction.

Our analysis of price effects show that block sales and, surprisingly, also block purchases, exhibit significant temporary price effects. This evidence provides support for previous findings by Gottardo and Murgia (2000) on the Italian Exchange. The interesting finding that block purchases induce short-run liquidity costs arises from the peculiar setting of the Italian market. The ownership of most companies listed is concentrated in a few large shareholders. Because of very high capital commitment required of block intermediaries acting in dual capacity, it is quite common for a large shareholder to be involved as a counterpart in a block transaction and block intermediaries to play the role of block brokers rather than dealers.

Consistent with previous findings, we document an asymmetric permanent price effect between block sales and block purchases. Block sales and block purchases show different patterns with respect to the two components of the permanent price impact. Whereas there is evidence of leakage of information associated with block sales, we find that block purchases induce strong post-trade price impacts that persist even sixty minutes after block trade execution.

We then turn to the analysis of liquidity effects associated with block trades. A common view is that block trades reduce liquidity in the market because they introduce a problem of adverse selection. Previous empirical research (e.g. Lee, Mucklow and Ready (1993) and Koski and Michaely (2001)) provides evidence supporting this view. We note that the analysis of these papers focuses on specific event periods (e.g. earning announcements) that are well known to convey private information. Here we focus on block trades that are associated with no particular event. In contrast with these works, we document that block trades induce an increase rather than a decrease in liquidity. This result would suggest that block trades resolve the information uncertainty associated with their arrival on the market by reducing the information asymmetry.

The second objective of this part of the dissertation is to investigate how effectively block trading activity in a separate trading venue affects downstairs trading activity. For this purpose we proceed in two steps. We first gauge the magnitude of block order flow on individual stock returns. This is done by running a regression model of each stock's return on stock's own order flow, the stock's block order flow and a proxy for aggregate order flow. We include one lag of stock own's order flow and aggregate order flow to take lagged adjustments in commonality into account. The results from the regression estimation show that stock's own order flow and aggregate order flow affect positively stock's own returns. There is also a positive relationship between the block order flow and stock returns, however we find that the magnitude of this relationship is quite small (about 0.04 basis points).

In a second stage of our analysis we gauge whether block trading activity is a source of interdependence across stocks. This allows us to assess the relative weight of block order flow as a factor of commonality in returns. We performed a sequential estimation analysis by examining the correlation of residual returns. We find that stock own order flow is the main source of the interdependence across stocks, followed by the aggregate order flow. Conversely, block trading activity induces no common effects across stocks. This result should not be surprising since, by their nature, block trades are infrequent and stock-specific transactions.

Consistently with previous evidence, our findings indicate that upstairs trading is not harmful to downstairs liquidity.

4.3 Intraday and interday effects in block trading activity: Evidence from the Italian Exchange

In Chapter 3 we investigate intraday and interday variations of block trading activity. The purpose is to detect whether there exists segmentation across trading hours and weekdays in block trading activity. We provided fresh evidence about the existence of segmentation in block trading activity.

We first examine the interday effects of block trades on stocks' returns and employed a measure of the impact on the individual stock's return within the day a block trade occurs. The results from ANOVA tests reveal that the mean current impact is significantly different on Thursdays. Surprisingly, there are no differential effects between block purchases and block sales.

We then investigate intraday and interday variations in block order flow. Block order flow is measured in terms of the number of block trades executed. At intraday level, we find that the number of block trades significantly differs in the last two trading hours, we interpret this result as block trading activity being increased and concentrated at the closing of the trading session. The interday tests show strong evidence of variations throughout weekdays in common block order flow. When we distinguish between block purchases and block sales some puzzling results arise. Purchase block order flow appears to be concentrated in the last two trading hours and on Wednesdays and Thursdays. Sale block order flow appears to be more intensive in the last trading hours and on a Tuesdays and on the last two weekdays.

We go further by examining changes in the estimated cost of execution for block trades throughout trading hours and weekdays. The cost of execution is computed as the difference, in absolute value, between the block price and the market price before block trade execution. We also employ the nonparametric Kruskal-Wallis test to better control for the effects of outliers. Intraday tests show that the estimated cost of execution is significantly different from zero from 11:30 to 12:30 A.M. and in the last trading hour for block purchases, while it is significantly different from zero in the first trading hour for block sales. At intraweek level, block purchases exhibit significant costs of execution on Wednesdays and Fridays, whereas, surprisingly, there is no evidence of interday variations for block sales.

To check for the robustness of our results we omit from our intraday and interday tests, first stock which had the largest number of block trades executed, Olivetti, and, second, outliers, that is observations with the estimated cost of execution larger than 1 in absolute value. We arbitrarily define these outliers on the basis of the distribution of the cost of execution. We investigate whether the intraday and interday patterns we documented previously still persist after excluding these observations from our analysis. Our results for the common sample from the analysis excluding Olivetti indicate, surprisingly, more trading hours that significantly differ from zero than in the case when Olivetti was included in the analysis. The cost of execution shows different pattern when we distinguish between block purchases and block sales. The cost of execution for block purchases significantly differs during the third trading hour (from 11:30 to 12:30 A.M.) and from after lunch hours on. Conversely, the cost of execution for block sales is significantly different in the first trading hour. At intraweek level, there is no evidence for interday variations in the cost of execution either for block purchases or block sales.

The results of intraday and interday tests when we exclude outliers from our analysis are similar to the case when we omit the Olivetti stock. The cost of execution for the common sample appears to significantly differ during the third trading hour, and from 1:30 P.M. onward, and on the last weekdays. We find that the cost of execution for block purchases also shows an intraday pattern similar to that for common sample, while the segmentation in the cost of liquidity appears to be concentrated on Friday. Surprisingly, we find no significant intraday variations in the cost of liquidity for block sales. The cost of execution appears to be significantly different in the last trading hour once we release observations with cost of execution larger than 0.1 in absolute value. Again, we were unable to document any significant variations in the cost of execution for block sales across weekdays.

Overall, our empirical findings suggest that intraday and interday variations of the cost of execution appear mostly to be driven by temporal patterns of block trades of the Olivetti stock. This is more noticeable for block purchases. Block trading activity for Olivetti stock tends to be concentrated during specific trading hours and weekdays. Once we drop block trades of this stock from our analysis, more trading hours are significantly different from zero. We interpret this result as showing that segmentation in the cost of execution appears to increase at least at intraday level. As far as block sales are concerned, intraday variations in block order flow and the cost of execution appear to dominate over interday variations. Our findings suggest that changes across trading hours reflect liquidity- rather than information-driven activity. However, our findings should be treated with caution because of the short time span of our sample.

4.4 Research agenda

This dissertation leaves open a number of questions which require further investigations.

So far we know little about cross regulatory arbitrage induced by block trades. Most studies have focused on comparisons of different market structures with a view to assessig market quality by examining the cost dimension of multiple listed stocks. It would be interesting to examine how and to what extent regulatory arbitrage arises in cross-border block trading activity, in particular between the three major European stock exchanges now that block trading activity on German equity markets is automated. A further extension might be a study of trading costs on the Amsterdam Exchange before and after the merger with Euronext markets. This would make it esasier for us to understand the effects of interaction rules enforced on that market.

Furthermore, it would be interesting to look through the issue of intraday dynamics of liquidity around blocks by examining other liquidity measures, such as the trading volume, the number of trades submitted, and possible order imbalances in the downstairs market. In particular, examining order imbalances with respect to block initiator would reveal trading strategies pursued by downstairs participants.

Another open question regards the intraday and interday regularities we documented in block trading activity. More robust results can be obtained by employing a larger sample and a longer period of analysis. For instance, a possible development might be the analysis of block trading activity in the after-hour market.