

Market Microstructure

The Impact of Fragmentation
under the Markets in Financial
Instruments Directive

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CFA Institute Centre for Financial Market Integrity

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Executive Summary

Since the enactment of the Markets in Financial Instruments Directive (MiFID) in Europe on 1 November 2007, European equity markets have undergone significant change. The Directive has acted as a catalyst for evolution, resulting in a proliferation of new trading platforms such as multilateral trading facilities, including dark pools (non-displayed platforms or other off-exchange venues), to supplement the incumbent exchanges. As a consequence, the Directive has greatly enhanced competition for equity trading. However, greater competition has created a number of challenges for market participants, as liquidity fragments across trading venues.

This study seeks to measure the extent of fragmentation and explore its effects on market microstructure, focusing on issues such as transparency, costs, and price formation. Our findings are derived from a CFA Institute membership survey and from empirical analysis.

The survey aims to provide evidence on investors' experiences since the implementation of MiFID, focusing on the extent of fragmentation and how it has affected issues such as transparency and costs. The empirical analysis quantifies fragmentation, then focuses on the nature and extent of changes in the price formation process since the implementation of MiFID. We consider the relationship between the trends identified in the price formation process and the extent of fragmentation.

The report is organised as follows: Section 1 provides an introduction and explains the background to the issues under consideration. Section 2 reviews the regulatory framework shaping European equity markets, focusing on the key MiFID provisions. The experience of the United States is reviewed in Section 3. We then examine the theory of fragmentation in Section 4 to provide context for the issues under consideration in the survey (Section 5) and data analysis (Section 6). Our conclusions and policy considerations are set out in Section 7.

Summary Policy Considerations

- The CFA Institute Centre for Financial Market Integrity (the Centre) finds no empirical evidence that fragmentation has been detrimental to the quality of the price formation process.
- Survey findings identify investor concerns regarding the quality and provision of consolidated data. The findings highlight the need for an accurate, complete, and clear picture of market prices. Investors should have fair access to such data.
- Accordingly, the Centre recommends that European authorities pursue the implementation of a consolidated data system for the provision of quote and trade data for European equity markets. A consolidated system would improve market transparency and best serve investors' needs.

Summary of Key Findings

It is evident from the survey findings and data analysis that the equity trading landscape is complex, with trends emerging at both the aggregate level and at the individual level.

- With regards to fragmentation, the primary exchanges have retained a dominant market share of European equity trading volumes since the implementation of MiFID. However, this has steadily declined as multilateral trading facilities (MTFs) have gained an increasing share of trading volumes over the period under review. Most notably, the United Kingdom is the most fragmented market, where MTFs have increased their share of volumes to approximately one-fifth.
- The impact of fragmentation on trading costs is somewhat mixed, illustrated by the survey findings. This likely reflects a combination of factors in addition to MiFID that have driven developments in trading costs (making it difficult to isolate MiFID). However, analysis of the data suggests that at least one measure of trading costs (average bid-ask spreads) have fallen in aggregate over the period since the implementation of MiFID.
- The survey also finds that investors have experienced difficulties fulfilling post-trade reporting obligations in the fragmented market environment, indicated by 68 percent of survey respondents. Furthermore, 64 percent of survey respondents indicated that fragmentation may have increased the cost of data access.

But overall, the analysis of the data suggests that fragmentation has not been detrimental for price formation.

- Firstly, as noted above, average bid-ask spreads have fallen at the aggregate level, a positive development for investors. This trend is particularly pronounced among U.K. equities. The United Kingdom is also the most fragmented market.
- Other metrics related to the quality of the price formation process reveal similarly benign outcomes. Price formation appears no more or less efficient since the implementation of MiFID; the process is approximately equal both before and after MiFID implementation. This suggests that fragmentation has had no material impact on market efficiency.
- Whilst stock price volatility has increased, this cannot be attributed to the extent of fragmentation. Specifically, we find no evidence of positive correlation between volatility and fragmentation. It is therefore most likely that the increase in volatility is attributable to other factors.

However, certain aspects of market structure could still be improved—most notably with respect to transparency and fair access to market prices.

- Significantly, 65 percent of survey respondents support the implementation of a mandated consolidated tape for European equity markets. It is evident from survey findings that certain investors find it costly or prohibitive to access multiple sources of data and/or liquidity, which can hinder the level playing field.
- Accordingly, the Centre recommends that European authorities pursue the introduction of a formal consolidated data system for quote and trade data for European equity markets. This should be introduced under MiFID in a properly calibrated fashion to improve overall market transparency, efficiency, and fairness.
- A consolidated system would improve the quality of data, facilitate the accomplishment and measurement of best execution, and level the playing field amongst market participants. Such a system would further improve market microstructure and contribute to an efficiently functioning single market for equities.

1. Introduction

The microstructure of securities markets—the structural factors which determine how investor preferences are revealed in prices and volumes—is crucial to the efficient functioning of markets. Microstructure is concerned with key issues such as trading costs, transparency, price formation, and market design. Interest in microstructure has grown of late, as developments in information technology, globalisation, and regulation have driven evolution in European equity markets. Collectively, these elements have contributed to a growth in new trading venues, a reduction in the dominance of the incumbent exchanges, and have changed the conduct of business amongst both trading venues and market participants. Accordingly, these forces have had a significant effect on market microstructure.

In particular, information technology has simplified connectivity and lowered costs to operators of trading venues and participants alike. This has simplified trade execution and led to efficiency gains. Equally, globalisation and regulatory developments, facilitated by advancements in technology, have resulted in more homogeneous market models, based on low-cost automated processes. As a result, barriers to entry have been lowered, enhancing competition between trading venues both domestically and internationally, which continues unabated. This has resulted in market fragmentation.

The most significant regulatory development to impact market microstructure in Europe—and the primary driver of fragmentation—is the enactment of the Markets in Financial Instruments Directive (MiFID). The directive came into force on 1 November 2007 and applies throughout the 27 European Union (EU) Member States¹ plus 3 European Economic Area (EEA) States.² MiFID forms a cornerstone of the European Commission's Financial Services Action Plan, which was designed to create a single market in financial services in Europe. MiFID is a wide-ranging piece of legislation governing securities markets, intermediation, and the provision and regulation of investment services. As such, it impacts most participants in the financial services industry and extends in scope beyond the provisions of its precursor, the Investment Services Directive.

The legislation was developed using the Lamfalussy approach (a four-level process comprising framework principles, implementing measures, regulatory co-operation and harmonisation, and enforcement). The primary aims of MiFID are to increase competition, market efficiency, and investor protection through the creation of a level playing field amongst financial markets, products, and services throughout Europe. The main topics addressed by the directive include: authorisation, regulation and passporting (the provision of services in Member States other than a firm's home Member State); client categorisation (which classifies clients as retail, professional, or 'eligible counterparties', with differentiated levels of investor protection); conflicts of interest; outsourcing; investment research; client disclosures; best execution; client order-handling; transaction reporting; and market transparency measures. The latter four topics are of particular relevance in the context of market microstructure and the impact of fragmentation.

Most significantly, MiFID effectively led to the abolishment of the concentration rule which existed in some countries. The concentration rule confined equity trading to the national regulated exchange of the home Member State. Following the implementation of MiFID, investment firms and market participants became able to execute trades via a range of alternative trading platforms, such as multilateral trading facilities³ (MTFs) and 'systematic internalisers',⁴ alongside the regulated exchanges. Such trading venues have made permissible pan-European trading via a single platform.

¹ Includes Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

² Includes Iceland, Liechtenstein, and Norway.

³ A multilateral system, operated by an investment firm or market operator, which brings together multiple third-party buying and selling interests in financial instruments.

⁴ A firm that internalises order flow to deal on its own account on an organised, frequent, and systematic basis and is subject to transparency requirements.

MTFs typically operate in a similar fashion to regulated exchanges, providing an electronic platform for multiple parties to interact and transact orders to buy and sell securities. MTFs are required to publish quotes in shares as well as details of executed trades, being subject to the same pre-trade and post-trade transparency measures as regulated exchanges (this is addressed in more detail in Section 2). However, there are certain conditions under which MTFs can waive pre-trade transparency obligations. This has facilitated a proliferation of dark pools, multilateral systems typically used for the crossing of large block orders.

In contrast, systematic internalisers are bilateral systems. Investment firms that act as systematic internalisers fill buy and sell orders from the firm's own inventory. The investment firm is the counterparty to all orders, thereby providing a bilateral venue for order execution. They are also subject to transparency requirements, although these requirements are narrower than for regulated markets and MTFs.

The Committee of European Securities Regulators' (CESR) MiFID database⁵ shows that, as of September 2009, there were 13 registered systematic internalisers in Europe, 129 MTFs, and 92 regulated markets (or exchanges). Systematic internalisers include, among others, some of the large banks such as Goldman Sachs International, Credit Suisse Securities Europe, and UBS. The largest MTFs include Chi-X Europe, BATS Europe, and Turquoise, as well as dark pools such as Liquidnet Europe, POSIT, and NYFIX Euro Millennium. Some of the largest regulated markets include LSE Group (London Stock Exchange), Euronext, and Deutsche Boerse. The relative market shares of these categories of trading venue are examined in detail in Section 6.2.1.

As a consequence of the proliferation of trading venues, there has been notable erosion in the market share of the incumbent exchanges. For example, regulated markets have seen their market share of European equity volumes fall from above 80 percent to about 65 percent (see Section 6.2.1).

Moreover, the resulting fragmentation of liquidity and trading volumes—and correspondingly, fragmentation of trade data—raises a number of issues for investors. For example, how does fragmentation impact market transparency and consequently the efficiency of price formation? Does fragmentation reduce or increase costs (such as bid-ask spreads, exchange fees, and other transaction costs) for investors? And how is the measurement of client 'best execution' affected by the proliferation of trading venues and trade data?

In short, this study explores the effects of fragmentation and its implications for investors. The afore-mentioned issues are examined in the context of a CFA Institute membership survey, supported by analysis of equity market data.

First, we begin with a review of the provisions of MiFID relevant to the market microstructure issues under consideration.

⁵ See www.cesr.eu/index.php?page=comingup_details&id=121.

2. Regulatory Framework

The framework principles for MiFID are set out in Directive 2004/39/EC⁶ (referred to as the ‘level 1 directive’ in the rest of the report). The directive establishes the principles necessary to allow investment firms to provide services throughout Europe on a competitive basis and to harmonise investor protections in the single market. The level 2 measures are set out over two documents, comprising an implementing directive and an implementing regulation. Specifically, Commission Directive 2006/73/EC⁷ (the ‘level 2 directive’) addresses organisational requirements and operating conditions for investment firms. Commission Regulation (EC) No. 1287/2006⁸ (the ‘level 2 regulation’) addresses record keeping obligations for investment firms, transaction reporting, market transparency, and admission of financial instruments to trading.

The key provisions of MiFID relevant to this study include best execution requirements, client order-handling rules, transaction reporting requirements, and pre- and post-trade transparency obligations. These provisions are summarised below.

2.1. Best Execution

Article 21 of the MiFID level 1 directive details the ‘Obligation to execute orders on terms most favourable to the client’. This provision requires that firms take relevant steps to ensure the best possible result for clients when executing orders. In order to meet this objective, firms must take into account “price, costs, speed, likelihood of execution and settlement, size, nature, or any other consideration relevant to the execution of the order”. Firms are also required to establish an order execution policy and provide this information to clients.

Article 44 of the level 2 directive provides further criteria for firms to take into account regarding best execution. In particular, investment firms must consider the characteristics of the client (retail or professional), the type of order, the characteristics of the financial instruments in question, and the characteristics of the trading venues through which the order can be executed. These are necessary considerations for investment firms when determining the best possible result for their clients.

Further provisions related to best execution are set out in Articles 45 and 46 of the level 2 directive.

2.2. Client Order-Handling

Article 22 of the MiFID level 1 directive addresses client order-handling rules. Investment firms are required to provide for “prompt, fair and expeditious execution of client orders”. In the case of limit orders that are not immediately executed, investment firms are required to make public those orders in order to ensure that they are executed as promptly as possible. This typically involves transmitting the unfilled client limit order to a regulated market and/or MTF.

The level 2 directive sets out further details. Article 47 requires investment firms to carry out comparable client orders sequentially and expeditiously and to promptly inform retail clients of any material difficulty in executing the order. The level 2 measures also set out criteria for the aggregation and allocation of client orders with transactions on own account of the investment firm.

2.3. Transaction Reporting

Transaction reporting (the submission of transaction reports to regulatory authorities⁹) is an important tool for market supervision. For example, transaction reports are used by regulatory authorities to detect instances of market abuse and to monitor for possible infringements of the provisions of MiFID. The legal framework for transaction reporting is set out in Article 25 of the level 1 directive. This requires investment firms “to report details of... [transactions in financial instruments admitted to trading on a regulated market] to the competent authority as quickly as possible, and no later than the close of the following working day.”

⁶ See <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2004L0039:20070921:EN:PDF>.

⁷ See <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:241:0026:0058:EN:PDF>.

⁸ See <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:241:0001:0025:EN:PDF>.

⁹ Regulators and supervisors are commonly referred to as ‘competent authorities’ throughout the Lamfalussy directives.

The transaction reporting requirements can be fulfilled either by the investment firm itself submitting reports to the regulatory authority, or, by a third party acting on its behalf; an approved trade matching and reporting system; or the regulated market or MTF through which the transaction was conducted.

The implementing measures are set out in the level 2 regulation, Articles 12 and 13. These articles stipulate the form and content of transaction reports to be submitted to the relevant competent authority in respect of transactions in financial instruments. Articles 14 and 15 detail provisions related to regulatory co-operation and exchange of information on transaction reports, in addition to detailing the content and timeliness of the information to be shared amongst supervisors.

2.4. Transparency Obligations

The requirement to make public quote and trade data for relevant securities forms a cornerstone of the MiFID provisions. Generally, transparent markets minimise informational asymmetries, enhance overall investor confidence, and thus improve the efficiency of the price formation process. These factors lead to better trading conditions for market participants.

The importance of transparency is best characterised by the level 2 regulation. Recital 5 notes that: “A high degree of transparency is an essential part of this framework, so as to ensure a level playing field between trading venues so that the price discovery mechanism in respect of particular shares is not impaired by the fragmentation of liquidity, and investors are not thereby penalised.”

The transparency obligations apply to shares admitted to trading on regulated markets and MTFs. There are also transparency requirements for systematic internalisers. We address pre-trade and post-trade transparency obligations in turn.

2.4.1. Pre-trade transparency

Pre-trade transparency ensures that price quotations and order sizes are visible and disseminated in financial markets. There are, however, pre-trade transparency waivers¹⁰ available for certain types of transactions. Most notably, transactions conducted through dark pools (typically large block trades conducted via an anonymous order-matching or crossing system) benefit from pre-trade transparency waivers, as well as large trades above a set threshold transacted elsewhere. Additionally, for large trades, it is permissible to delay post-trade reporting.

The pre-trade transparency principles are set-out in the MiFID level 1 directive. Generally, price quotes and depth of volume at those prices must be made available to the public on reasonable commercial terms and must be timely. Article 27 applies to systematic internalisers (‘obligation for investment firms to make public firm quotes’); Article 29 addresses the pre-trade transparency requirements for MTFs; and Article 44 details the requirements for regulated markets.

The implementing measures are set out in the level 2 regulation. Chapter IV, section 1 covers pre-trade transparency for regulated markets and MTFs (Articles 17–20), while section 2 covers pre-trade transparency for systematic internalisers (Articles 21–26).

¹⁰ MiFID allows regulatory authorities to grant exemptions from the obligation to disclose pre-trade data such as bid-offer quotes and order sizes. Such ‘waivers’ are detailed under Articles 18 and 20 of Commission Regulation 1287/2006. The categories of waivers include: (1) ‘market model’ waiver where the price is determined by reference to a price generated by another system (i.e., a reference price), or where the price is determined via a ‘negotiated transaction’ under certain conditions; (2) ‘type of order’ waiver, where orders are held in an order management system to facilitate the breaking-up of that order into manageable sizes; and (3) ‘large in scale’ orders which are larger than normal market size by reference to average daily turnover of the shares in question.

In particular, Article 17 states that an operator of an MTF or regulated market shall “make public continuously throughout its normal trading hours” the aggregate number of orders and shares at each price level, for a continuous auction order book trading system.¹¹ Likewise, for a quote-driven trading system,¹² the market operator shall make public the best bid and offer of each market maker in that share, together with volumes.

Pre-trade data is illustrated below. The ‘Level II’ screenshot display provides a view of market participant orders on the London Stock Exchange. The yellow strip at the top of the order book highlights the best bid and ask price and volume that are available for the security. The depth of the quote is shown in strips beneath:

Unilever PLC										
Last	Time	Chg	%Chg	Vol	CVol	ACVol	High	Low	Headlines	
18.36	10:42:58a	-0.08	-0.43%	100	760511	743487	18.52	18.30	7	
Open	PrClose	PrVol	AVWAP	VWAP	EPS	Div Status	OLS	EMS	Ctry Code	
18.44	18.44	6322522	18.42	18.42	1.38	N/A	1	3000	GB	
Food: Major Diversified										GB00B10RZP78
19 13,948 18.35 - 18.36 9,696 5										
Num	MPart	Size	Tick	Bid	Ask	Tick	Size	MPart	Num	
+ 19		13,948		18.35	- 18.36		9,696		5	
+ 9		7,696		18.34	- 18.37		9,003		9	
+ 8		8,951		18.33	- 18.38		17,533		13	
+ 7		4,852		18.32	- 18.39		10,080		12	
+ 5		6,253		18.31	- 18.40		7,967		10	

Source: FactSet

For systematic internalisers, Article 24 requires quotes to be maintained, as close to real time as possible, which are close in price to comparable quotes at other trading venues. However, these requirements only apply to orders up to standard market size in liquid markets (defined by reference to average daily turnover). Annex II Table 2 in the level 2 regulation sets out the thresholds for large transactions and standard market sizes.

2.4.2. Post-trade transparency

Post-trade transparency requirements ensure that the price, volume, and time of executed transactions in shares are made public, on reasonable commercial terms, as close to real time as possible. Such requirements are designed to improve the efficiency of price discovery.

For certain transactions that are deemed to be ‘large in scale’ compared with normal market size, it may be possible to delay publication of the details of the transaction. Delayed publication of large transactions allows those parties to the transaction time to offset or hedge the risks inherent in their positions. This helps minimise market impact costs – the risk of adverse price movements that would otherwise affect the parties concerned upon revelation of the transaction to the market.

The post-trade transparency principles are set-out in the MiFID level 1 directive. Article 28 applies to systematic internalisers (‘post-trade disclosure by investment firms’); Article 30 addresses the post-trade transparency requirements for MTFs; and Article 45 sets out the principles for regulated markets.

The implementing measures are contained in the level 2 regulation. The provision to delay post-trade reporting is detailed in Article 28, which permits deferred publication for certain large transactions. The deferral period varies according to the size of the transaction by reference to the average daily turnover for that security.

¹¹ Annex II Table 1 of the level 2 regulation defines a continuous auction order book trading system as “A system that by means of an order book and a trading algorithm operated without human intervention matches sell orders with matching buy orders on the basis of the best available price on a continuous basis.”

¹² Annex II Table 1 of the level 2 regulation defines a quote-driven trading system as “A system where transactions are concluded on the basis of firm quotes that are continuously made available to participants, which requires the market makers to maintain quotes in a size that balances the needs of members and participants to deal in a commercial size and the risk to which the market maker exposes itself.”

Moreover, Article 27 sets out the obligations for investment firms (including systematic internalisers), regulated markets, and MTFs to make public details of executed trades. In particular, the following post-trade information must be made public: trading day and time of execution, instrument identification code, unit price, price notation or currency, quantity of shares traded, and the execution venue.

Post-trade data is illustrated in the screenshots below. The first screenshot shows details of the most recent transactions, referred to as ‘time and sales’, for a given stock:

Time and Sales												
FP-PAR												
Total S.A.												
EUR												
Euronext France												
Last	Time	Chg	%Chg	Bid	Ask	Vol	CVol	Turnover	AWWAP	VWAP	Open	PrClose
42.38	17:29:57	0.52	1.24%	41.88	41.88	147	10548200	449909.16	N/A	42.65	42.38	41.87
Time	Price	Vol	Exch	Bid	BSize	ASize	Ask	CVol	VWAP	Status		
17:29:57	42.385	147	PAR	42.375	1,32	147	42.385	10,548,200	42.6527			
17:29:56	42.385	102	PAR	42.385	190	7,338	42.390	10,548,053	42.6527			
17:29:56	42.385	88	PAR	42.385	190	7,338	42.390	10,547,951	42.6527			
17:29:55	42.385	201	PAR	42.330	1,236	185	42.440	10,547,863	42.6527			
17:29:55	42.385	49	PAR	42.330	1,236	185	42.440	10,547,662	42.6527			
17:29:53	42.390	50	PAR	42.385	440	5,185	42.390	10,547,613	42.6527			
17:29:52	42.385	91	PAR	42.370	3,701	864	42.385	10,547,563	42.6527			
17:29:52	42.385	773	PAR	42.370	3,701	864	42.385	10,547,472	42.6527			
17:29:52	42.385	29	PAR	42.370	3,701	893	42.385	10,546,699	42.6527			
17:29:51	42.385	116	PAR	42.370	3,701	893	42.385	10,546,670	42.6527			
17:29:48	42.380	344	PAR	42.320	150	185	42.440	10,546,554	42.6527			
17:29:48	42.380	1,165	PAR	42.365	1,749	2,009	42.380	10,546,210	42.6527			
17:29:48	42.380	500	PAR	42.365	1,749	2,509	42.380	10,545,045	42.6528			
17:29:48	42.380	500	PAR	42.365	1,749	2,509	42.380	10,544,545	42.6528			
17:29:48	42.380	983	PAR	42.320	150	185	42.440	10,544,045	42.6528			
17:29:47	42.380	517	PAR	42.365	1,200	1,983	42.380	10,543,062	42.6528			
17:29:47	42.380	44	PAR	42.365	1,200	1,983	42.380	10,542,545	42.6528			
17:29:44	42.360	7	PAR	42.360	5,071	2,544	42.380	10,542,501	42.6528			
17:29:44	42.375	339	PAR	42.335	528	9,164	42.405	10,542,494	42.6528			
17:29:43	42.375	2,000	PAR	42.360	4,878	2,000	42.375	10,542,155	42.6529			
17:29:43	42.375	102	PAR	42.360	4,878	2,102	42.375	10,540,155	42.6529			
17:29:42	42.375	500	PAR	42.360	973	1,610	42.375	10,540,053	42.6529			
17:29:42	42.375	248	PAR	42.360	973	2,358	42.375	10,539,553	42.6529			
17:29:42	42.375	845	PAR	42.360	973	2,358	42.375	10,539,305	42.6529			
17:29:42	42.375	3,200	PAR	42.375	3,203	2,831	42.380	10,538,460	42.6530			
17:29:42	42.375	3	PAR	42.375	3,203	2,831	42.380	10,535,260	42.6530			
17:29:42	42.375	90	PAR	42.360	232	90	42.375	10,535,257	42.6530			
17:29:42	42.375	170	PAR	42.360	232	90	42.375	10,535,167	42.6530			
17:29:33	42.360	91	PAR	42.355	474	2,831	42.380	10,534,997	42.6530			
17:29:33	42.360	973	PAR	42.355	474	973	42.360	10,534,906	42.6530			
17:29:33	42.360	151	PAR	42.345	1,200	209	42.375	10,533,933	42.6531			
17:29:33	42.360	604	PAR	42.355	474	1,124	42.360	10,533,782	42.6531			
17:29:33	42.360	288	PAR	42.330	1,060	7,735	42.390	10,533,178	42.6531			
17:29:32	42.360	100	PAR	42.330	1,060	6,990	42.390	10,532,890	42.6531			
17:29:32	42.360	100	PAR	42.330	1,060	6,990	42.390	10,532,790	42.6531			
17:29:32	42.360	100	PAR	42.355	474	2,216	42.360	10,532,690	42.6531			
17:29:32	42.360	100	PAR	42.355	474	2,316	42.360	10,532,590	42.6531			
17:29:32	42.360	170	PAR	42.365	277	307	42.375	10,532,490	42.6531			
17:29:32	42.365	107	PAR	42.365	277	307	42.375	10,532,320	42.6531			
17:29:32	42.365	170	PAR	42.365	277	307	42.375	10,532,213	42.6531			
17:29:32	42.365	137	PAR	42.325	5,311	6,382	42.405	10,532,043	42.6531			
17:29:28	42.365	433	PAR	42.355	607	5,235	42.390	10,531,906	42.6531			
17:29:26	42.370	190	PAR	42.310	4,165	185	42.440	10,531,473	42.6531			
17:29:26	42.370	10	PAR	42.315	1,369	185	42.440	10,531,283	42.6531			
17:29:26	42.365	51	PAR	42.340	400	9,817	42.390	10,531,273	42.6531			
17:29:26	42.365	118	PAR	42.330	1,957	9,017	42.390	10,531,222	42.6531			

Source: FactSet

Secondly, a trade montage for European stocks (example: Total S.A.) illustrates the venue, date and time of execution, identifier, unit price, volume, and so forth, across all European venues where the stock is traded:

Total S.A. (EUR)											
											Currency: Euro
Venue	Symbol	D	Last	Volume	Time	Date	Status	VWAP	Cum Vol	Bid - Ask	Size
Berlin	TOTB-BER	D	42,000	0	08:38:54	16-Oct-09		--	0	42,340 42,350	300 x 300
Chi-X	TTA-CHIX	R	42,390	14	16:29:53	16-Oct-09		42,109	3,356,839	42,355 42,335	921 x 170
Duesseldorf	TOTB-DUS	D	42,780	90	09:45:07	16-Oct-09		42,614	160	42,340 42,360	100 x 500
Frankfurt	TOTB-FRA	D	42,260	1,400	17:10:00	16-Oct-09		42,806	31,232	42,330 42,360	2,500 x 2,500
Hamburg	TOTB-HAM	D	42,190	100	16:50:26	16-Oct-09		42,703	910	42,340 42,360	1,181 x 1,181
Hannover	TOTB-HAN	D	42,810	0	09:17:36	16-Oct-09		--	0	42,340 42,350	1,190 x 1,190
London	TTA-LON	D	41,145	0	--	04-Apr-08	NEG	42,711	31,771	-- --	0 x 0
Munich	TOTB-MUN	D	42,180	250	16:50:27	16-Oct-09		42,520	2,580	42,320 42,350	240 x 240
Paris	FP-PAR	D	42,335	100	17:28:47	16-Oct-09		42,654	10,519,399	42,325 42,345	1,509 x 131
Plus Markets Group	TTA-PLU	D	42,335	0	16:25:01	16-Oct-09		--	0	41,280 43,390	500 x 500
Turquoise	TTA-TROX	R	42,350	100	16:29:16	16-Oct-09		42,613	798,500	42,365 42,355	300 x 200
XETRA	TOTB-ETR	D	42,310	300	17:17:42	16-Oct-09		42,664	73,063	42,340 42,370	100 x 565

Source: FactSet

Post-trade data for over-the-counter transactions are shown in the separate montage below:

Total S.A. (EUR)											
											Currency: Euro
Source	Symbol	D	Last	Time	Date	Volume	Status	Venue	Cum Vol	VWAP	Prev Close
BOAT	FP.PAR.EUR-BOAT	D	42,379	14:42:49	16-Oct-09	95	MKT	OTC	5,937,090	43,045	41,773
Chi-X	FP.PAR.EUR-COTC	R	42,270	15:08:00	16-Oct-09	60			33,152	--	41,933
Deutsche Borse	FP.PAR.EUR-DOTC	D	42,310	15:38:04	16-Oct-09	48		OTC	0	--	42,230
Euronext	FP.PAR.EUR-UOTC	D	42,318	17:24:03	16-Oct-09	44		OTC	485,421	--	41,920
London Stock Exchange	FP.PAR.EUR-LOTC	R	42,213	15:14:41	16-Oct-09	502	NEG	LON	31,771	--	41,631
Vienna Stock Exchange	FP.PAR.EUR-WOTC	D	43,019	11:29:00	16-Oct-09	3,100		OTC	3,100	--	40,010

Source: FactSet

2.5. Summary

In brief, the rules require investment firms to deal promptly and fairly with client orders and to achieve the best possible outcome, having regard to price, timeliness, and cost of execution. Transparency obligations require details of completed trades, such as prices and volumes, to be reported to the market and to regulatory authorities. Pre-trade information on price quotes and trading interest must also be publicly disclosed, although exemptions exist, most commonly for large orders and for orders executed on the basis of a 'reference price'.

3. Experience from the United States

Fragmentation is not a new phenomenon. The United States has experienced fragmentation, to varying degrees, as its securities markets have evolved over the decades. Over time, equity markets—exchanges, electronic communications networks (ECNs), broker-dealers/internalisers—have become increasingly integrated, facilitating the interaction of orders across different trading venues. As in Europe, technology and regulatory developments have played an important role in shaping the changes in U.S. market microstructure. For example (amongst others), technological developments have facilitated faster execution speeds, whilst decimatisation of price quotes has narrowed spreads and led to better prices for investors. The experience of the United States therefore provides useful context for the trends emerging in Europe.

The key regulatory development in the United States has been the establishment of the National Market System, following the Securities Acts Amendments in 1975. The aim of the Amendments was to create a system that provided for greater competition between markets and operators; that promoted transparency (such that the best prices were visible and accessible to market participants); and that made markets interconnected. In 2005, the rules governing the National Market System were consolidated by the Securities and Exchange Commission (SEC) into ‘Regulation NMS’ (analogous to MiFID in Europe). The rules require execution policies based on price priority as a means to ensure that customers get best execution. Automated orders cannot ‘trade-through’¹³ the best prices, providing price protection to customers posting limit orders. Among others, the rules require fair and non-discriminatory access to prices, and improvements to the consolidation and dissemination of market data.

Two key features of the National Market System, each of which has parallel relevance to MiFID in Europe, are transparency and linkages.

3.1. Transparency

Generally, transparency improves the efficiency of price discovery as price quotes and transactions are visible to all participants, thus ensuring that investors trade at accurate and fair prices, promoting market confidence. Transparency also promotes competition as dealers/market makers are encouraged to post the best prices to attract order flow.¹⁴ Regulation to promote transparency in U.S. equity markets under Regulation NMS includes, among others, the Limit Order Display Rule. This requires dealers holding customer limit orders which equal or better the current market price to execute those orders immediately or display them to the market.

Moreover, the NMS mandates the existence of both pre-trade and post-trade transparency for listed shares. The Consolidated Tape Association¹⁵ (CTA) manages the Consolidated Quote System (CQS), which provides pre-trade transparency, and the Consolidated Tape System (CTS), which provides post-trade transparency (the CQS and CTS are collectively referred to here as the ‘consolidated tape’). All SEC registered exchanges and market centres send trades and quotes to a central data consolidator, from which the CQS calculates and disseminates the National Best Bid and Offer (NBBO) for each security, based on price, size, and time-priority. Similarly, the CTS consolidates post-trade data (such as price, volume, time of trade) for each security, which is disseminated to the market via the tape.

¹³ A ‘trade-through’ is an order that is not executed at the best possible price in relation to quoted prices at other venues.

¹⁴ It should also be noted that too much transparency can, in some circumstances, be detrimental, if market participants fear adverse price movements if their preferences are revealed. This scenario could lead to a reduction in liquidity, with volumes migrating to ‘dark’ (non-displayed) platforms or other off-exchange venues. In essence, too much transparency could itself be a source of fragmentation.

¹⁵ The CTA oversees the dissemination of real-time quote and trade information for securities listed on the New York Stock Exchange and American Stock Exchange. Since the late 1970s, all SEC-registered exchanges and market centres offering trading in securities listed on the NYSE or AMEX send their quotes and trades to a central consolidator, where the Consolidated Quote System and Consolidated Tape System data streams are produced and distributed. More information, including a list of CTA participants, can be found at <http://www.nyxdata.com/cta>

3.2. Linkages

Historically, inter-market linkages have connected the trading venues under the National Market System and enabled customers to access the best prices across market centres.¹⁶ Such electronic linkages facilitate the routing of orders to the venue that offers the best price for the customer at the point of execution. In essence, linkages permit the interaction of orders between different venues and thus act as a centralising force. Combined with the transparency provided by the consolidated tape, linkages have generally made it practical and measurable for brokers to achieve best execution for their clients.

In recent years, technological advancements, such as smart order routing, have furthered brokers' ability to meet their best execution requirements. Such technology operates by directing orders (or parts of orders, broken up into relevant sizes) to those markets that can fill them at the best price and in the most timely fashion. Such 'upstairs' linking mechanisms have largely replaced the traditional 'downstairs' linking mechanisms between exchanges.

However, in spite of these developments, orders may not always fully interact between markets. For example, inducements—such as payment for order flow, bundling of fees—mean that brokers do not automatically route orders to the best venue (instead, trades may be routed to the venue that pays the broker a fee or commission for the order flow). Furthermore, brokers/investment firms may internalise orders (that is, fill the client's order from the firm's own inventory or by crossing trades among different customers). Such internalisation is not subject to pre-trade transparency requirements (in contrast to Europe). Therefore internalisers can attract order flow without actually posting the best price to the market. At the extreme, internalisation can be detrimental if it discourages market makers from posting narrower spreads to attract orders.

Innovation in trading techniques, such as high-frequency trading strategies, may also affect order interaction. Technological developments have led to a rise in algorithmic trading¹⁷ and the use of techniques such as flash orders¹⁸ (or order 'pinging'). Such trading techniques are built upon ultra-fast electronic connections and computer programs requiring little or no human intervention. Such low-latency trading, facilitated by co-location,¹⁹ means that trades can be executed or cancelled within microseconds.

Regulatory concerns have been raised with regards to flash orders. These concerns relate to whether such orders result in unfair access to market quotes, thus enabling certain participants to profit at the expense of others. In addition, those posting such orders may receive rebates from the trading venue concerned for supplying liquidity. This can lead to trading strategies designed to profit from the liquidity rebate irrespective of the quoted spreads or prices transacted.

In short, orders may not always interact efficiently, and fragmentation can persist.

3.3. Parallels to Europe

As noted in the previous section, MiFID mandates both pre-trade and post-trade transparency; however there is no formal consolidated data system to centralise the reporting of quote and trade data. In Europe, it is incumbent upon brokers to link markets by seeking out the best venues for execution of client orders. As with the United States, brokers are increasingly reliant on order routing technology to facilitate best execution.

¹⁶ The National Market System led to the implementation of the Intermarket Trading System (ITS), an electronic linkage between exchanges facilitating the transmission of orders to the venue offering the best price. Such linkages between exchanges are referred to as 'downstairs' linkages; the ITS made it incumbent upon the exchange to route the order to the venue offering the best price. 'Upstairs' linkages refer to the routing of orders from the point of the broker to the relevant venue.

¹⁷ Reports cite that high-frequency trading accounts for over 70 percent of U.S. equity trading volume. See, for example, www.ft.com/cms/s/0/d5fa0660-7b95-11de-9772-00144feabdc0.html.

¹⁸ Orders that are displayed, or flashed, for a small fraction of time (in microseconds) to select market participants before public dissemination. If not immediately filled, such orders are typically cancelled and thus not disclosed.

¹⁹ The practice of physically locating IT systems next to the servers of the exchanges and/or market centres.

However, the effectiveness of electronic order routing systems is critically dependent on the level of transparency. Orders can only be routed correctly if there is readily available and reliable pre-trade data on prices and trading interest at each execution venue. Competition amongst trading venues fragments the sources of such data. It follows that achieving best execution—acquiring relevant data, accessing multiple trading venues, and utilising routing technology—can be costly in a fragmented marketplace. This raises concerns that those costs are ultimately passed on to investors or that they are prohibitive to the extent that smaller investment firms are less able to compete.²⁰

In essence, the European regulatory framework is based around the same transparency principles as in the United States; however it operates in a decentralised fashion, allowing market forces to determine certain aspects of microstructure. Intuitively, the decentralised nature of the European market may accentuate the issues related to fragmentation.

The theoretical underpinnings of fragmentation are examined in the next section. The impact of fragmentation is measured in Sections 5 and 6.

²⁰ Under true (or perfect) competition, one would expect such costs to be eroded over time as providers engage in price competition. In practice, barriers to competition and discriminatory access may limit the extent to which participants can benefit.

4. Fragmentation

In practical terms, fragmentation is the decentralisation of orders across trading venues. It is a by-product of competition as trading venues proliferate.

Fragmentation occurs on several levels. Firstly, an increase in the number of trading venues disperses order flow (assuming a competitively priced service offering), resulting in multiple pools of liquidity. By extension, decentralisation of liquidity reduces order sizes across venues. This is because as liquidity is dispersed, it becomes necessary to trade in smaller sizes to minimise market impact. In conjunction with smaller order sizes being traded, a higher number of trades may be needed to complete customer orders. In Europe, such trends have emerged clearly in recent years and are most conspicuous for large-cap equities.²¹

Secondly, fragmentation diffuses trade data on prices and volumes, via the multiplication of data sources (that is, originators of trade data such as investment firms, exchanges, and MTFs). In turn, this creates challenges for data vendors (and subsequently end users) in collecting, consolidating, and disseminating trade data.²² Such challenges may be compounded by the latitude afforded to investment firms in fulfilling their trade reporting obligations under MiFID (for example, OTC trades may be reported by the investment firm, by an exchange/MTF, or delegated to a third party). In short, fragmentation exists in many layers that affect the quality of trade data.

Whilst these issues can pose problems for investors, it is also true that fragmentation can be beneficial. For example, competition amongst trading venues can lower direct costs as operators compete for market share. Competition also enhances investor choice as different markets develop to serve the various needs of a range of investors. For example, some investors may favour speed of execution (the time taken to execute an order) over absolute price; those placing large orders may wish to minimise market impact costs and so favour anonymous or 'dark' trading facilities for order execution, perhaps at the expense of speed. The development of different trading facilities and variations in market design can therefore help meet investors' specific needs.

We discuss the implications of fragmentation for investors in greater depth below. First, the theory of fragmentation is reviewed. A central theme to the afore-mentioned issues is the notion of decentralisation versus consolidation.

4.1. Theoretical Background

Fragmentation stems from the market microstructure literature, which examines the structural factors that determine the process of financial intermediation. A detailed overview of the microstructure literature can be found, for example, in Francioni, Hazarika, Reck, and Schwartz (2008), Madhavan (2000, 2002), Stoll (2003), and Biais, Glosten, and Spatt (2004). A key aspect of microstructure is the analysis of trading frictions, such as bid-ask spreads and commissions, and their effect on transactions.

The early literature focuses on inventory-based models to analyse trading costs, such as the bid-ask spread. Such inventory models are based on the interaction between the supply of liquidity (the placement of limit orders) and the demand for liquidity or immediacy (the placement of market orders). The interaction between liquidity suppliers and demanders determines the formation of equilibrium prices. These models are largely based around dealer-driven or quote-driven markets in which the bid-ask spread reflects market makers' compensation for supplying immediacy. The spread widens (narrows) as the market maker's inventory moves away from (closer to) its target level. In other words, the spread reflects the risk associated with the dealer's position and his willingness to trade at that level. More recently, the literature has evolved to focus on models of order-driven markets and the role of asymmetric information. Such information-based models are based upon the interaction between informed traders, liquidity traders and noise traders, and the role of expectations (homogeneous or otherwise).

²¹ See, for example, Committee of European Securities Regulators, *Report on Impact of MiFID on Equity Secondary Markets Functioning*, June 2009. The report finds a decrease in average trade sizes, coupled with an increase in the number of trades, since the implementation of MiFID.

²² See, for example, European Securities Markets Expert Group, *Fact Finding Regarding the Availability of Post-Trade Data in Equities in the EU*, March 2009. The report notes problems related to the quality, availability, and aggregation of post trade data.

Informed investors gain when uninformed investors place a firm bid or ask quote, thus supplying a free trading option to those investors with superior information.

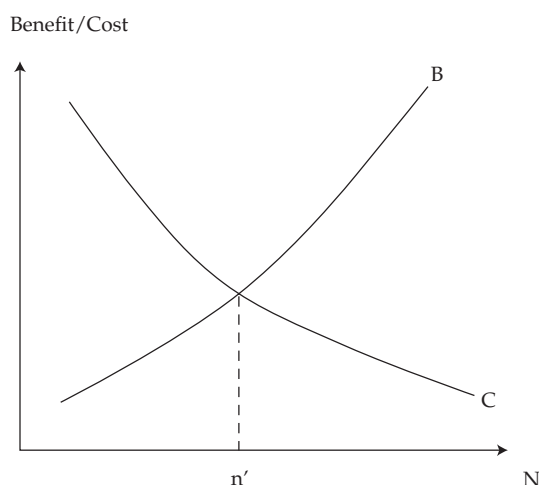
The concept of fragmentation originates from the microstructure literature in that it represents a source of friction that has important implications for price formation, transparency, and costs.

We can model fragmentation in simple terms as follows.²³ Consider an incumbent trading venue, such as an exchange. The economic function of the exchange is to amass liquidity, to facilitate the process of price discovery, and to execute trades. For simplicity, assume that liquidity increases with the number of participants that use the exchange. Then the benefits of the exchange (its ability to fulfil its economic function) increase as the number of participants that use it increase. This relationship characterises positive network externalities; the more participants that use the network (the exchange), the greater the collective benefit.

Similarly, market participants benefit from economies of scale, such that exchange costs per user decrease as the number of users increase. That is, the network operates more efficiently the more participants use it, thus lowering the average cost per user of the network.

It follows that network externalities and economies of scale are centralising tendencies that are increasing functions of the number of users. This is depicted graphically in **Figure 1**, which shows average benefit per user of the network (B) increasing, and average cost per user (C) decreasing, as the number of market participants (N) increases. For all points to the right of n' , $B > C$, hence the operation of the exchange yields net benefits.

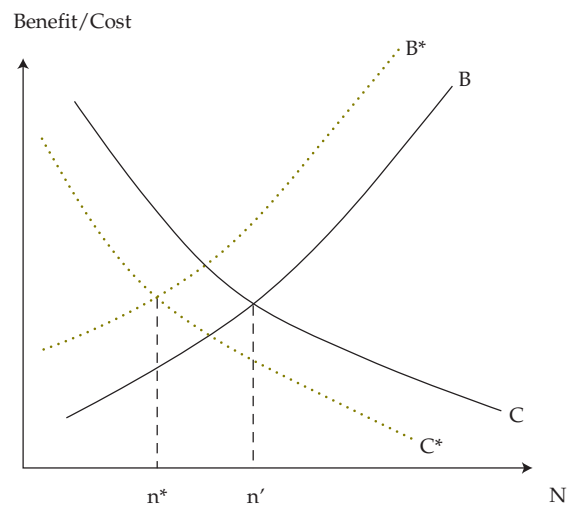
Figure 1



Now consider the introduction of a new trading venue. For simplicity, assume that the new venue is an electronic platform built on superior technology to the incumbent exchange (we can further simplify this distinction by thinking of the incumbent exchange as a traditional floor-based venue). The introduction of the new trading venue presents competition; the superior technology of the new platform is such that costs per user are lowered and network benefits increased for any given number of market participants. For example, the new electronic platform simplifies access to prices and trading interest (it is not confined by physical location), and greater automation in the trading process increases speed and reduces direct costs relative to the incumbent exchange.

This scenario is illustrated in **Figure 2**. For any given value of N, average benefit per user is higher, and average cost per user is lower, for the electronic platform relative to the incumbent exchange. This is depicted by the shift in the cost-benefit curves from C to C* and from B to B*.

²³ The analysis largely draws from Stoll (2008).



Note that the efficiency gains under the new technology are such that fewer market participants are needed for the new trading platform to be profitable, represented by the breakeven point $n^* < n'$. Assuming that the new venue doesn't create significant new liquidity in the short term, it follows that competition fragments liquidity.

In the above model, this is not problematic provided that $N \geq n^*$. However, as competition increases further and trading venues proliferate, market participants become even more dispersed. Moreover, as the number of users per venue declines, existing network benefits are eroded. In particular, the smaller is N , the greater the risk that costs per user will exceed the benefits. In essence, there likely comes a point—a critical mass—beyond which proliferation of trading venues no longer yields net benefits ($B \leq C$). Graphically, this point must lie somewhere to the left of n^* . In this case, fragmentation can be disadvantageous to market participants.

The key to avoiding the detrimental effects of fragmentation is to ensure connectivity between trading venues so that orders submitted to different platforms can interact with each other. Order interaction centralises the market place (it consolidates liquidity) and counteracts the opposing effect of fragmentation. In the above example, this would imply that the average benefit curve becomes independent of the number of users per venue (a horizontal curve). Instead, average benefit becomes a function of the *aggregate* number of market participants across all trading venues.

In order for order interaction to be permissible, it is necessary for markets to be transparent—so that investors can access prices and trading interest in all markets—and that markets are linked, so that orders can be routed to the best market for execution. This requires a market framework based upon pre-trade and post-trade transparency principles and a best execution requirement to ensure that brokers seek out (via order-routing technology or otherwise) the best markets. It follows that impediments to transparency and market connectivity can mean that fragmentation could prove detrimental, decentralising liquidity and deteriorating the quality of price discovery. Intuitively, inventory risk is greater in thinner decentralised markets, placing upward pressure on bid-ask spreads. Furthermore, if limit orders cannot fully interact, the efficiency of equilibrium price formation may be impaired. Such markets further benefit informed traders at the expense of uninformed (often smaller) investors.

Costs are an important factor for the efficient functioning of the market place. Whilst we have seen that competition can lower up-front costs per user (such as exchange fees), the investment in technology needed to gain access to all markets to facilitate order interaction can be significant. In order to see prices and trading interest across all markets, further costs may be borne acquiring consolidated data from commercial vendors (this may be accentuated in the absence of a consolidated tape). More pertinently, if such access costs prohibit full transparency

and connectivity, secondary effects can arise in the form of increased market costs, such as bid-ask spreads and commissions. In practice, one might expect some costs to fall but others to rise as a result of competition.

Indirect costs must also be considered. These primarily take the form of market impact costs (the risk of adverse price movements upon executing a trade) and opportunity costs (the profit foregone from a missed trade). Both costs may be greater in fragmented markets with decentralised liquidity. To minimise market impact costs, a number of trading venues have developed that provide for non-displayed orders and anonymous trading. Such venues, known as dark pools, are popular facilities for the execution of large block trades.

4.2. Dark Pools

Dark pools are essentially anonymous order-matching or crossing systems that facilitate the execution of (typically) large transactions. In Europe, dark pools benefit from pre-trade transparency waivers, principally since price determination is typically based on a negotiated price or reference price (such as the mid-point of the quoted bid-ask prices on the primary exchange) or by virtue of the size of transactions conducted, which may be large in scale relative to average daily turnover. The absence of pre-trade transparency requirements means that investors can execute large block trades without revealing their preferences to the market until after the order has been filled.²⁴ This minimises market impact costs since investors avoid adverse price movements which would otherwise occur upon the revelation of such large orders in the market. However, drawbacks exist. For example, investors executing orders through dark pools may sacrifice speed of execution as large orders typically take longer to fill (or match with an equal and opposite order). Such precise order-matching can sometimes take days to accomplish. But the existence of such dark pool platforms can be viewed as a positive development in facilitating investor choice; factors such as speed, fill rate, and market impact can be evaluated in relative importance, and the investor can choose the best execution venue accordingly.

As implied earlier, price discovery does not generally occur within dark pools. Rather, such platforms utilise the price discovery function conducted through the 'lit' order books of regulated exchanges and MTFs, which are the primary sources of liquidity. In this sense, some may consider dark pools to have a 'free ride' off the economic service of exchanges and lit MTFs—they utilise their price discovery function but largely do not contribute to it. A problem arises if such pools proliferate and take market share away from the lit platforms. Firstly, overall market transparency may be impaired as an increasing volume of trading takes place with non-displayed orders. Secondly, a fall in volumes elsewhere can impair liquidity, thus deteriorating the quality of price discovery. This is not only detrimental to market participants of exchanges/MTFs (or other lit platforms); it is also detrimental to dark pools themselves, since their price determination is based upon the prices discovered on the primary exchanges.

In essence, there are both benefits and drawbacks to dark pools, all of which are closely related to the nature and extent of market fragmentation.

Next, we seek to quantify some of the issues discussed here: namely the extent of fragmentation and its implications for issues such as costs, transparency, and the quality of price formation. This is examined through evidence from a CFA Institute survey (Section 5) and data analysis (Section 6).

²⁴ Dark pools are still required to fulfil post-trade transparency obligations.

5. Survey

We surveyed the CFA Institute global membership in order to obtain feedback on market fragmentation in Europe, focusing on issues such as transparency, costs, and execution quality. The poll was designed to gauge investors' experiences on how these issues have been affected since the introduction of MiFID.²⁵

The CFA Institute membership includes more than 100,000 investment analysts, portfolio managers, investment advisers, and other investment professionals in 135 countries. The views of this informed and diverse range of investment professionals provide valuable and insightful feedback into the issues under consideration.

The 12-question survey was e-mailed to a stratified random sample of 23,414 CFA Institute members on 29 June 2009, and the survey closed on 17 July 2009. To enhance the relevance and validity of responses, only members involved in investing, trading, or processing orders in European equity markets were invited to participate.²⁶

The key findings are summarised below. The survey questions are presented and analysed in Section 5.2.

5.1. Summary of Findings

In short:

- The survey findings provide a mixed picture on trading costs.
- Respondents clearly indicate that the cost of data access has increased and find problems fulfilling trade reporting obligations in a fragmented trading environment.
- Respondents also express concerns related to dark pools.
- Most significantly, members express strong support for a mandated consolidated tape for European equity markets.

5.1.1. Fragmentation

Regarding the extent of fragmentation amongst European equity markets, 41 percent of respondents agreed or strongly agreed that MiFID has created a significant fragmentation of trade volume, and 40 percent agreed or strongly agreed that it has created a significant fragmentation of trade data (20 percent disagreed or strongly disagreed with both assertions). Around 40 percent were unsure over the extent of fragmentation.²⁷

Regarding the impact of fragmentation, of those who had an opinion, the most significant finding was that 68 percent of respondents believe that fragmentation has made trade reporting obligations harder; and 64 percent believe it has increased the cost of data access. A further 42 percent believe fragmentation has impaired price discovery, and 45 percent said it has made client best execution harder. Just under one-third of respondents felt that fragmentation has had no impact on these factors.

²⁵ The questions were developed with valuable input from the European Commission.

²⁶ Of the 1,732 members who responded to the survey, 962 were eligible based on their professional capacity, for a response rate of 4.1 percent. The confidence interval is ± 3.1 percent at the 95 percent confidence level. Margin of error varies significantly by question as the number responding to each question varies. No opinion responses have been excluded where appropriate.

²⁷ Volume fragmentation is analysed in greater detail in Section 6.2.1. The incumbent exchanges have retained a majority market share in all markets, although this has steadily receded.

5.1.2. Costs

Overall, respondents were mixed on how MiFID has affected fees, bid-offer spreads, trade execution speed, and overall transaction costs. Respondents were relatively evenly spread: some indicated that these costs have increased; some respondents indicated that they have decreased; and others believe MiFID has had no impact on these implicit and explicit transaction costs.

Of those respondents who had an opinion, the clearest majority view related to bid-offer spreads, where 52 percent felt that MiFID has had no impact on spreads (20 percent felt that spreads have increased and 29 percent believe that spreads have decreased). This may reflect a perception that factors other than MiFID may have accounted for any changes in bid-offer spreads, such as the recent financial crisis.²⁸

Overall, the mixed responses on costs reflect a combination of factors in addition to MiFID that have driven developments in trading costs (making it difficult to isolate MiFID). Furthermore, depending on the measure of cost and the degree of granularity examined, costs may have risen or fallen.

5.1.3. Transparency

Approximately half of respondents believe the level of pre- and post-trade transparency in equity markets has not changed under MiFID.

Regarding the provision of consolidated data, approximately 40 percent of respondents believe commercial vendors are effective (somewhat or completely) in providing pre-trade and post-trade consolidated data. However, just over one-third of respondents were unsure, whilst around one-fifth thought that commercial vendors were ineffective. These results suggest that investors perceive room for improvement in the provision of consolidated data.

Moreover, given these somewhat inconclusive findings, it is not surprising that the majority of respondents (65 percent) said that a formally mandated consolidated tape would be beneficial (somewhat or very) for European equity markets in terms of overall market transparency, efficiency, and fairness. This perhaps reflects the view that some participants currently find it difficult to get a complete and clear picture of prices and trading interest across all markets.

Furthermore, approximately 60 percent of professionals with experience in both European and U.S. markets favour the consolidated tape system in the United States to the decentralised transparency regime in Europe.

Respondents were largely unsure on whether the existing pre-trade transparency waivers under MiFID are appropriate. Approximately half of respondents had no opinion, whilst the remaining half were split equally between those that believe the waivers are appropriate and those who believe they are inappropriate.

Most respondents—between 54 percent and 59 percent—indicated it would be valuable (somewhat or very) to extend pre- and post-trade transparency requirements under MiFID to transactions in instruments other than shares. Amongst the instruments listed, the highest majority opinion related to corporate bonds, with support from 59 percent of respondents.²⁹

5.1.4. Dark pools

Of those respondents who had an opinion, approximately 70 percent think that the operations of dark pools are problematic (somewhat or very) for price discovery and for market volatility. Fifty-eight percent think they are problematic for market liquidity. An analysis of respondents by country indicates that investor sentiment on dark pools is consistent between professionals in both European and U.S. equity markets.

²⁸ Bid-offer spreads are analysed in detail in Section 6.2.2. The data suggest that, overall, average spreads have decreased, however there is significant variation amongst individual stocks.

²⁹ Note the caveat that these results are based on the opinions of equity market participants, by design of the survey. These respondents may or may not be participants in other non-equity markets.

5.1.5. Overall

At a high level, respondents were split on whether the implementation of MiFID in Europe has been successful in achieving its objectives, with 27 percent saying yes and 41 percent saying no. A further 32 percent had no opinion.

5.2. Survey Results and Analysis

Q1: In your professional capacity, do you invest, trade, or process orders in the following equity markets?	Count	Column %
Europe only	315	18%
United States only	226	13
Europe and United States	421	24
Not eligible	770	44
Sample size	1,732	

Q2: For each statement below, please select either the consolidated tape in the United States (which centralises trade and quote data for equity securities) or the decentralised trade and quote reporting system in Europe; if you do not prefer one over the other, please select no difference.	Consolidated Tape in the United States	Decentralised Trade and Quote Reporting System in Europe	No Difference
<i>(Asked only of those who are involved in equity markets in both Europe and the United States)</i>			
Provides greater market transparency (N=247)	62%	13%	25%
Makes price discovery more efficient (N=245)	64	12	23
Makes client best execution easier (N=232)	58	14	28
Provides greater market confidence (N=224)	57	16	28

Market participants with experience in both Europe and the United States consistently prefer the centralised quote and trade reporting system in the United States to the decentralised transparency regime in Europe. Most notably, respondents believe that the consolidated tape system makes price discovery more efficient (64 percent) and markets more transparent (62 percent). This implies that investors consider having better access to all prices across all markets in the United States compared with Europe. These findings are consistent with the results of Question 8, in which a majority of respondents favour the introduction of a European consolidated tape.

Q3: In your view, how has MiFID affected the following implicit or explicit transaction costs?	Increased	Decreased	No Impact
<i>(Asked of those involved in equity markets in Europe)</i>			
Fees (paid to trading venues) (N=265)	25%	35%	39%
Bid-offer spreads (N=246)	20	29	52
Trade execution speed (N=260)	23	29	47
Overall transaction costs (N=253)	34	33	33

The mixed responses on costs are perhaps reflective of the complexity of the trading landscape. To a certain extent, some of the developments witnessed in equity markets—for example, a reduction in direct fees and in latency—can be attributed to non-regulatory factors, such as technological developments and innovation in trading methods. Although the introduction

of MiFID is likely to have facilitated these developments, it is possible that such phenomena would have evolved regardless (albeit perhaps less rapidly). In this respect, one might expect a reasonable proportion of 'no impact' responses, particularly regarding fees and execution speed, as the implementation of MiFID is likely not unique in accounting for these developments.

The highest 'no impact' response relates to bid-offer spreads (52 percent). Again, this may reflect a perception that factors other than MiFID may have accounted for any changes in bid-offer spreads, such as the recent financial crisis. Bid-offer spreads are examined in detail in Section 6.2.2. Overall, the data illustrate that average spreads have slightly decreased since the inception of MiFID; however, there is significant variation amongst individual stocks. Furthermore, there is some evidence that spreads have narrowed within some of the most fragmented markets. These trends reinforce the perception of a complex trading landscape and in part corroborate the mixed survey findings with respect to bid-offer spreads.

Respondents are evenly spread regarding the effect of MiFID on overall transaction costs. This reflects a combination of factors in addition to MiFID that have driven developments in trading costs (making it difficult to isolate MiFID) and the fact that, depending on the measure and degree of granularity, costs may have risen or fallen.³⁰

Q4: How do you perceive the level of transparency in equity markets to have changed under MiFID?	Made Better	Made Worse	No Impact
<i>(Asked of those involved in equity markets in Europe)</i>			
Pre-trade transparency (N=266)	32%	16%	52%
Post-trade transparency (N=264)	38	13	49

Half of respondents indicate that the level of market transparency has not significantly changed under MiFID. However, it is not clear from these results whether this half of respondents perceive the level of transparency to be good or poor (only that it is approximately equal in both periods). Only around one-third of respondents believe the level of transparency to be better since the implementation of MiFID.

Q5: To what extent do you agree or disagree that MiFID has created a significant fragmentation of trade volume and trade data?	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Sure
<i>(Asked of those involved in equity markets in Europe)</i>					
Trade volume (N=355)	2%	18%	32%	9%	39%
Trade data (N=356)	1	19	30	10	41

Combined, one-fifth of respondents disagree that MiFID has led to a significant fragmentation of trade volume and trade data, whilst two-fifths agree with the assertion. The extent of fragmentation is examined in detail in Section 6.2.1. The incumbent exchanges have retained a dominant market share of trading volumes across all major markets, although this has steadily declined over the period since the implementation of MiFID.

³⁰ These findings are broadly consistent with the conclusions of both the June 2009 CESR report on the impact of MiFID on equity secondary markets functioning and the July 2009 Oxera report on monitoring prices, costs, and volumes of trading and post-trading services. The CESR report notes that whilst some direct costs have fallen, smaller trade sizes and smaller quantities available at the best price have led to a higher number of executions on multiple venues to complete an order, thereby increasing overall trading costs. The Oxera report finds that, among others, average costs per trade have fallen; however costs per value of trading have not systematically decreased or increased.

Q6: How, if at all, has fragmentation affected the following:	Improved	Impaired	No Impact
<i>(Asked of those involved in equity markets in Europe)</i>			
Price discovery (N=250)	26%	42%	31%
	Made easier	Made harder	No impact
Trade reporting obligations (N=241)	11%	68%	20%
Client best execution (N=251)	27	45	29
	Reduced	Increased	No impact
Cost of data access (N=247)	7%	64%	29%

Fragmentation appears to have had the most significant impact on trade-reporting obligations and on the cost of data access. Of those with an opinion, approximately two-thirds of respondents believe that these factors have been negatively affected by fragmentation.

Post-trade reporting obligations may be fulfilled through a number of channels. For example, trades can be reported by the investment firm conducting the transaction, by an exchange/MTF, or delegated to a third party such as a data vendor/distributor. The latitude afforded to firms (particularly in the case of off-exchange trades) may increase the propensity for confusion over the responsibility for trade reporting. This could lead to both missed trades and double-counted trades.³¹ Taking these factors into consideration, it is perhaps not surprising that the majority of respondents think that fragmentation has had a detrimental impact on trade reporting.

A related issue is the cost of data access. As market fragmentation disperses trade data on prices and volumes, it may become more costly to obtain, aggregate, and disseminate market data to investors and other end-users. Such access costs may encompass the investment in technology needed to connect to a greater number of trading venues to access prices and trading interest, as well as data vendor fees and other search costs. These factors would explain why a majority of respondents believe that the cost of data access has increased.

The findings also show that more than two-fifths of respondents believe that fragmentation has negatively affected price discovery and best execution. Nearly one-third felt there was no impact on these factors. Price discovery and best execution are related: if the formation of equilibrium prices is impaired, it becomes difficult to seek out the best prices for execution of client orders. Hence, we might expect similar results for these issues. Although many respondents indicate that market fragmentation has been detrimental for price discovery and best execution, there is no clear consensus.

We consider the quality of price formation in greater detail in Section 6.2.2.

Q7: How effective are commercial vendors in providing investors and market participants with consolidated pre- and post-trade data for European equities?	Completely Ineffective	Somewhat Ineffective	Somewhat Effective	Completely Effective	Not Sure
<i>(Asked of those involved in equity markets in Europe)</i>					
Pre-trade data (N=357)	4%	19%	36%	4%	36%
Post-trade data (N=356)	4	17	37	5	36

³¹ See, for example, the March 2009 ESME report on fact finding regarding the availability of post-trade data in equities in the EU. The report cites, among others, instances of multiple reporting of the same trade, incorrect trade reports, varying quality of market data, and varying time delays in post-trade reporting, all of which cloud the consolidated picture of post-trade data.

The responses to Question 7 indicate that there is room for improvement in the provision of consolidated pre-trade and post-trade data to market participants.³² More than one-fifth of respondents believe that existing consolidated data offerings by commercial vendors are to some extent ineffective, whilst approximately one-third were unsure. The absence of strong support for such offerings (only around 5 percent of respondents felt such data provision was completely effective) is consistent with the responses to Questions 2 and 8 (see below), which indicate a majority support for a formal consolidated tape.

Q8: In your view, how beneficial, if at all, would a formally mandated consolidated tape be for European equity markets in terms of overall market transparency, efficiency, and fairness?	Count	Column %
<i>(Asked of those involved in equity markets in Europe)</i>		
Not beneficial at all	13	4%
Not very beneficial	37	10
Somewhat beneficial	121	34
Very beneficial	110	31
No opinion	75	21
Sample size	356	

The results illustrate that 65 percent of respondents believe that a formal consolidated tape would be beneficial for European equity markets. This perhaps reflects the view that some participants currently find it difficult to get a complete and clear picture of prices and trading interest across all markets in a fragmented environment (reinforcing the responses to Question 7).

Whilst some market participants are likely to have sufficient size and scale to obtain a complete picture of the markets, it is possible (particularly given the responses to Question 6) that certain investors find it costly or prohibitive to access multiple sources of data and/or liquidity. In this respect, the market may not be considered a level playing field. The results here indicate that respondents would favour a mandated consolidated tape to address such deficiencies.³³

The infrastructure supporting the creation of a consolidated tape for quote and trade data would require the creation of a central data repository for quote and trade information throughout EU equity markets. The tape would act as the central access point to that data, providing fair, consistent access to prices for all investors, and providing an accurate and clear view of market activity for all participants.

Whilst there are noted drawbacks to such a mandated regime—for example, centralised provision of pre- and post-trade data could stifle competition and innovation³⁴—it should also be remembered that transparent, accessible data is one building block of market structure: it is a means to an end (an efficiently functioning market) rather than an end in itself.

Furthermore, it is likely that the drawbacks are not insurmountable. Firstly, existing data vendors would likely continue to offer consolidated data on a commercial basis, with different service offerings providing data in varying levels of depth, with associated analytical tools, to serve the varying needs of investors. Irrespective of the introduction of a mandatory tape, demand for commercial data would likely remain high, encouraging innovation.

³² Several data distributors currently provide consolidated pre-trade and post-trade data offerings. Examples include Thomson Reuters' 'x' consolidated data for Reuters Instrument Codes, and Equiduct's 'Orange VBBO'. The Thomson Reuters 'x' provides the best bid and offer for a stock across all trading venues as well as listing trades from all venues. Equiduct's offering is a virtual order book that consolidates visible pre-trade information from relevant markets. Consolidated data offerings vary in stock coverage but generally focus on the most actively traded, liquid equities.

³³ Other reports and surveys indicate that the majority of buy-side professionals also prefer the introduction of a consolidated tape—see, for example, the Investment Management Association's response to the CESR call for evidence on the impact of MiFID on equity secondary markets functioning.

³⁴ See, for example, the March 2009 ESME report, which discusses the potential drawbacks from monopolistic supply of market data. Other practical issues related to a mandated consolidated tape include implementation costs and political considerations related to physical location of the central data consolidator.

Some of the views expressed by respondents to Question 8 are captured in **Box A**.

Box A: Investors' views on a consolidated tape for European equity markets

'It is paramount to be able to have a correct overall "picture" of what goes on in the market for analytical as well as regulatory purposes.'

'This is one area that was left to "competition" with MiFID implementation, unfortunately, not all stakeholders had a say. A consolidated tape would be absolutely crucial in providing pre-trade transparency, and it should help enforce a greater harmonisation of "print" discipline across venues.'

'Trade reporting fragmentation makes it hard to assess volume and price trends and damages transparency.'

'One tape for one instrument renders the proof of best execution much easier and is probably fairer for small investors that cannot see every pocket of liquidity. We are basically creating the same problems as those we have on the OTC markets.'

'We are a private client IM and a small player in overall markets. While, post MiFID we have not [had] problems meeting and monitoring client "best execution", it is far from clear that we are achieving the most effective and efficient access to liquidity.'

'We already have consolidated depth of market via MDM and AQRC in Bloomberg. Large blocks can be posted under the delayed criteria using various platforms but these are not as cleanly captured as before as some are double/triple-counted or include dividend in/out trades that inflate real trading volumes.'

Q9: In your view, how problematic are the operations of so-called dark pools for overall price discovery, liquidity, and volatility?	Not Problematic at All	Not Very Problematic	Somewhat Problematic	Very Problematic
<i>(Asked of those involved in Europe and/or U.S. equity markets)</i>				
Price discovery (N=407)	9%	21%	45%	26%
Market liquidity (N=406)	14	29	39	19
Market volatility (N=394)	9	23	43	26

Disaggregation of the results to this question illustrates consistent findings between both U.S. and European respondents.

Overall, more than two-thirds of respondents believe that dark pools are to some extent problematic for price discovery and market volatility. A further 58 percent believe they are problematic for market liquidity. These views are consistent with the notion that, as dark pools proliferate, they may take market share away from exchanges and other lit trading venues where prices are discovered. This could, in some cases, lead to thinner markets, a reduction in liquidity and greater volatility, which may be detrimental to the quality of price discovery.

Some of the views expressed by respondents to Question 9 are captured in **Box B**.

Box B: Investors' views on dark pools

'By not being able to adequately gauge the depth of the market, through public information on volumes and prices, investors can interpret market movements incorrectly.'

'Too much of the institutional volume off exchange means volume can be made inaccurate/unrepresentative. The need for large institutions to execute privately is understood, but dark pools are too much of an information depriving solution for participants as a whole.'

'Dark pools compete for liquidity with "normal" exchanges, therefore for not-so sophisticated investors price discovery/liquidity can be problematic.'

'Anything that masks the available liquidity at various price points from market participants is prima facie bad for markets and for investors at large.'

'Anonymous execution through systems such as dark pools provides an alternative to traditional execution, but must be combined with it to achieve best outcomes.'

'In Europe, and I would have thought in the U.S. too, there is little difference between there being liquidity in dark pools or liquidity in "iceberg" orders in the market or a block "upstairs" being worked by a sales trader...These dark pool venues can often provide improvement in price/liquidity.'

Q10: In your view, are the existing pre-trade transparency waivers (i.e., the possibility to trade on a regulated market or an MTF without disclosing trading interest) in MiFID appropriate? There are currently three categories of waivers: 'market model' using a reference price, 'type of order' (e.g., iceberg orders), and 'large in scale orders' for trades above a specified threshold.

(Asked of those involved in equity markets in Europe)

	Count	Column %
Yes, the waivers are appropriate	84	24%
No, the waivers are not appropriate	78	23
No opinion	183	53
Sample size	345	

Respondents were divided on this issue; the half who had an opinion on the appropriateness of existing pre-trade transparency waivers were equally split between 'yes' and 'no' opinions. The split responses are perhaps indicative of the inherent complexity in assessing the appropriateness of the waiver thresholds.³⁵

Some of the views expressed by respondents to Question 10 are captured in **Box C**.

Box C: Investors' views on pre-trade transparency waivers

'In principle the waivers are wrong, but the need for large orders to be protected from exposure is not entirely inappropriate.'

'They are appropriate as they focus on "size" orders, which encourage the possibility of block crossing.'

³⁵ The pre-trade transparency waivers are detailed under Articles 18 and 20 of the level 2 regulation. Further detail is provided in footnote 10.

Q11: How valuable would it be to extend pre- and post-trade transparency requirements under MiFID, in a properly calibrated fashion, to transactions in instruments other than shares?	Not Valuable at All	Not Very Valuable	Somewhat Valuable	Very Valuable	No Opinion
<i>(Asked of those involved in equity markets in Europe)</i>					
Corporate bonds (N=345)	6%	8%	33%	26%	27%
Asset-backed securities (N=344)	6	7	28	28	32
Collateralised debt obligations (N=344)	6	8	27	27	32
Asset-backed commercial paper (N=343)	6	8	27	27	33
Credit default swaps (N=342)	5	8	25	31	31

Over half of respondents—between 54 percent and 59 percent—indicated it would be valuable to extend pre- and post-trade transparency requirements under MiFID to transactions in instruments other than shares. Amongst the instruments listed, the highest majority opinion relates to corporate bonds, with 59 percent support amongst respondents.

Several of these instruments currently have little secondary market activity (such as asset-backed commercial paper and collateralised debt obligations), which perhaps explains the relatively high number of ‘no opinion’ responses (around one-third). The microstructure of the markets for these instruments is also very different from that of equity markets. For example, the corporate bond and credit default swap markets are dealer-driven markets dominated by large banks who primarily conduct over-the-counter transactions. Transactions in these securities are often handled as principal trades rather than agency trades; as such, the true costs are less readily apparent to most investors. Credit instruments also typically trade in larger sizes than equities. Hence any mandatory transparency regime would need to be properly calibrated to the specificities of the structures of these markets. It is perhaps for this reason that the responses indicate a certain degree of caution: whilst a majority support extending MiFID pre- and post-trade transparency requirements to these instruments, the support is marginal rather than emphatic.³⁶

Some of the views expressed by respondents to Question 11 are captured in **Box D**.

Box D: Investors’ views on extending MiFID transparency requirements to instruments other than shares

‘The market in corporate bonds is about 25 years behind equities markets in transparency and execution cost efficiencies.’

‘This could be a useful development to encourage on-screen depth, and greater consistency in pricing across different market makers.’

‘To the extent that many analysts/risk managers use CDS spreads as indicators in models/systems, increased transparency around what drives movements in spreads can be very useful.’

‘Transparency is essential for fixed income assets and MiFID would be the right tool to get it in the fixed income space.’

‘These are investment vehicles for professionals; requirements for transparency thus should be lower.’

³⁶ A caveat of these results is that certain non-equity market participants were excluded by design of the survey, which is oriented toward equity markets.

Q12: Overall, do you think the implementation of MiFID in Europe has been successful in achieving its objectives (i.e., increasing competition and creating a level playing field in equities)?	Count	Column %
<i>(Asked of those involved in equity markets in Europe)</i>		
Yes	93	27%
No	141	41
No opinion	111	32
Sample size	345	

At the overall level, respondents are mixed on the success of MiFID since its implementation, with less than one-third believing that MiFID has been successful. In short, this indicates that more work is to be done to make MiFID a success.

Some of the views expressed by respondents to Question 12 are captured in **Box E**.

Box E: Investors' views on the overall success of MiFID

'[There are] still too many hidden corners in the market with different instruments and trading venues where disclosure is not made. Impact, timing and operational costs are not transparent to the client.'

'[The] best indicator is the reduction in trading fees, not least by two factors: (i) rise of electronic trading platforms... and (ii) price transparency for customers because of competition among broker/dealers.'

'Exchange competition has increased, but the playing field in equities resembles a cratered lunar surface.'

'The exchanges still have a wider responsibility than MTFs, therefore operationally, it cannot be even. The lack of a consolidated ticker and lack of consistent default rules across venues (where there is a conflicting definition of an OTC trade) encourages exploitation of fragmentation, rather than efficient arbitrage of the differences, that would otherwise encourage harmonisation.'

'It has increased competition in the visible areas where costs were already low, at the expense of accurate security pricing and execution costs—which [have] a much greater if less apparent cost.'

'I suspect much would have happened through normal commercial competition, albeit at a slower pace. The bigger (less talked about) downside is higher cost in terms of management time and regulation.'

6. Data

The aim of this section is two-fold: firstly, to quantify the magnitude of fragmentation in European equity markets; and secondly, to establish the nature and extent of changes in the price formation process since the implementation of MiFID. To this end, certain metrics related to the quality of price formation are examined and compared prior to and post the implementation of MiFID. The empirical analyses are designed to supplement the survey findings in Section 6, which primarily focus on the issues of costs and transparency.

Fragmentation is examined in terms of market share of nominal trading volumes across different trading venues. Fragmentation is analysed at the aggregate level for European stocks, as well as amongst the major European stock indices.

The price formation process is analysed in the context of the following metrics which are indicative of market quality: (i) bid-ask spreads (a measure of indirect trading costs); (ii) volatility (a function of liquidity and market confidence); and (iii) tests of the randomness of price movements (a measure of market efficiency).

The key findings are summarised below. The data are presented and analysed in Section 6.2.

6.1. Summary of Findings

In short:

- The primary exchanges have retained a dominant market share of equity trading since the implementation of MiFID. However, this has steadily declined as MTFs have gained an increasing share of trading volumes over the period under review.
- With regards to the price formation process, average bid-ask spreads have decreased at the aggregate level since the implementation of MiFID; however, differences exist at the individual stock level and between countries. Most notably, there is some evidence that average spreads have fallen in the most fragmented markets, namely the United Kingdom and France (although it is difficult to establish a formal statistical relationship).
- The volatility of prices has increased significantly since the implementation of MiFID; however, factors such as the financial crisis may largely explain the trends witnessed. There is no evidence of positive correlation between increases in volatility amongst individual stocks and the extent of fragmentation.
- Tests of the randomness of price movements indicate no structural differences in the efficiency of price formation since the implementation of MiFID. Price movements appear equally efficient (at least in the information sense) both pre- and post-MiFID implementation.

6.1.1. Fragmentation

At the aggregate level—measured by trading volumes of companies comprising the Dow Jones Stoxx 600 index—the market share of MTFs has risen from nearly zero immediately prior to the implementation of MiFID to more than 10 percent. The most fragmented market is the United Kingdom, where the market share of regulated exchanges of FTSE 100 stocks has declined from more than 70 percent prior to the implementation of MiFID to around 50 percent. At the same time, the market share of MTFs in FTSE 100 stocks has risen from 1 percent to nearly one-fifth; over-the-counter (OTC) trading volumes account for the remainder of the difference. Spain is the least fragmented market, where MTFs account for less than half a percent of trading volumes in IBEX 35 stocks.

6.1.2. Price formation

Bid-ask spreads. Analyses of the quality of the price formation process suggest, firstly, that average bid-ask spreads have decreased at the aggregate level since the implementation of MiFID, although this varies amongst individual stocks and countries. Examination of the changes amongst individual stocks illustrates that those stocks that have experienced a reduction in spreads are primarily domiciled in the United Kingdom and France, the two most fragmented

markets. However, it is not possible to establish a formal relationship, based on tests of correlation, between the change in spreads and the extent of fragmentation across the full sample.

Volatility. Secondly, volatility of European stocks has increased at both the aggregate level and at the individual stock level. There is also evidence of negative correlation between increases in volatility and fragmentation, although the relationship is relatively weak. Moreover, analysis of the changes in stock price volatility between the two review periods (pre- and post-MiFID implementation) suggests that sectoral factors related to the financial crisis may explain the trends witnessed.

Randomness of price movements. Finally, tests of the randomness of price movements (a measure of market efficiency), measured by the existence of unit roots in autoregressions of stock prices, suggest that price formation is no more or less efficient since the implementation of MiFID. The price formation process is approximately equal, with no evidence of structural breaks. This would at least suggest that fragmentation has not had any material impact on market efficiency.

6.2. Data Results and Analysis

First, the extent of fragmentation within the major European markets is measured. Second, we assess the nature and extent of changes in the price formation process by examining the metrics identified at the start of Section 6.

6.2.1. Fragmentation

Here, fragmentation of trading volumes is measured by the market share of the different trading venues since implementation of MiFID in November 2007.

Monthly volumes across trading venues have been obtained from Thomson Reuters market share reports.³⁷ The different trading venues have then been categorised as a regulated market (RM) or multilateral trading facility (MTF),³⁸ based on the classifications in the Committee of European Securities Regulators' MiFID database.³⁹ For each month, volumes within each category have been aggregated, and expressed as a percentage of the total volume of shares traded. Over-the-counter (OTC) volumes are represented by trades reported through Markit BOAT, a trade reporting platform that investment firms (including systematic internalisers) and MTFs use to report their off-exchange trades.⁴⁰

Fragmentation is analysed firstly at the aggregate level for European stocks, based on the constituents of the Dow Jones Stoxx 600 index (a broad-based index of 600 large-, mid-, and small-capitalisation European companies). Secondly, fragmentation is analysed at the country level, based on the market share of trading volumes for the major stock indices in five of the largest European markets, namely, France, Germany, Italy, Spain, and the United Kingdom. Finally, average trading volumes are analysed for a sample of European stocks to examine the relation between fragmentation and volumes at the individual stock level.

³⁷ The data are available at www.thomsonreuters.com/products_services/financial/financial_products/products_az/regulatory_compliance_mifid. Further useful information and statistics on market fragmentation can be found at <http://fragmentation.fidessa.com/>.

³⁸ MTF volumes include volumes transacted through certain dark pool platforms registered under the MTF category in the CESR database.

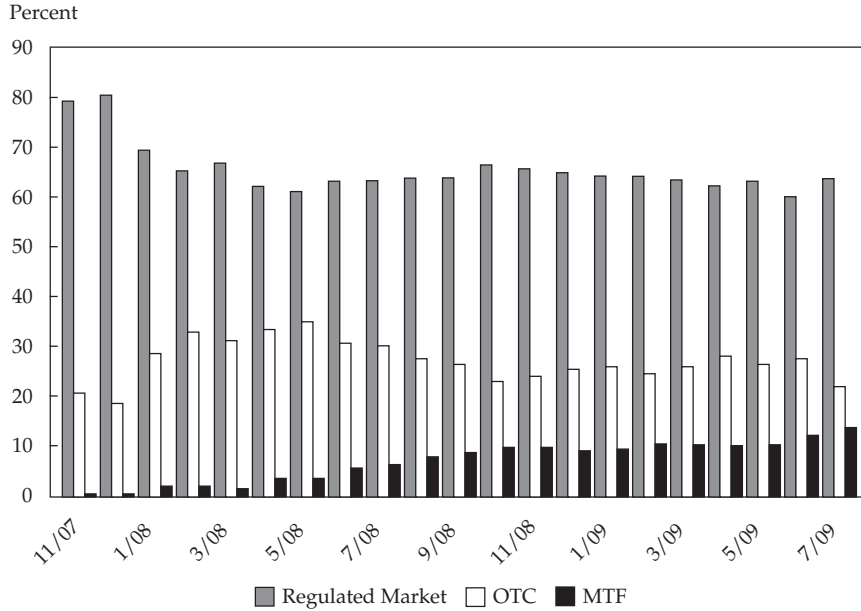
³⁹ See www.cesr.eu/index.php?page=comingup_details&id=121.

⁴⁰ There are three caveats to the data. Firstly, trades have been categorised according to the venue where the trade was reported. Therefore, actual OTC volumes may be slightly higher than those captured by Markit BOAT, since certain exchange operators also provide OTC reporting platforms. Categorising the data in this manner mitigates any inconsistency due to re-classifications between RM and OTC reporting venues within the underlying data. Secondly, some venues operate both a RM and MTF under the CESR MiFID database. Such venues have been categorised as *either* a RM or MTF according to whichever platform is largest. This does not materially impact the results. Thirdly, it is difficult to accurately and cleanly capture trading activity attributable to dark pools and systematic internalisers. Some dark pools (such as, among others, Liquidnet and Posit) are registered under the CESR database as MTFs. However, certain dark crossing networks operated by banks/broker-dealers may not be adequately captured under the CESR classifications. In addition, disaggregated data on systematic internalisers is not cleanly captured by the underlying data; the Markit BOAT volume figures per Thomson Reuters market share reports include trades marked as both 'OTC' and 'SI' from Markit's feed. The figures are therefore illustrative of overall trends rather than precise numbers.

6.2.1.i. Europe: Dow Jones Stoxx 600 Index

Figure 3 illustrates that, at the European level, the market share of MTFs has grown steadily over the review period, from around zero in November 2007 to almost 14 percent in July 2009. This has coincided with a fall in the market share of regulated exchanges from approximately 80 percent to 65 percent. The volume of OTC trading (as reported by Markit BOAT) has fluctuated over the review period, ranging between approximately 20 percent and 35 percent of the total volume traded. Most significantly, whilst trading volumes have gradually fragmented over the period, regulated markets have retained a dominant share.

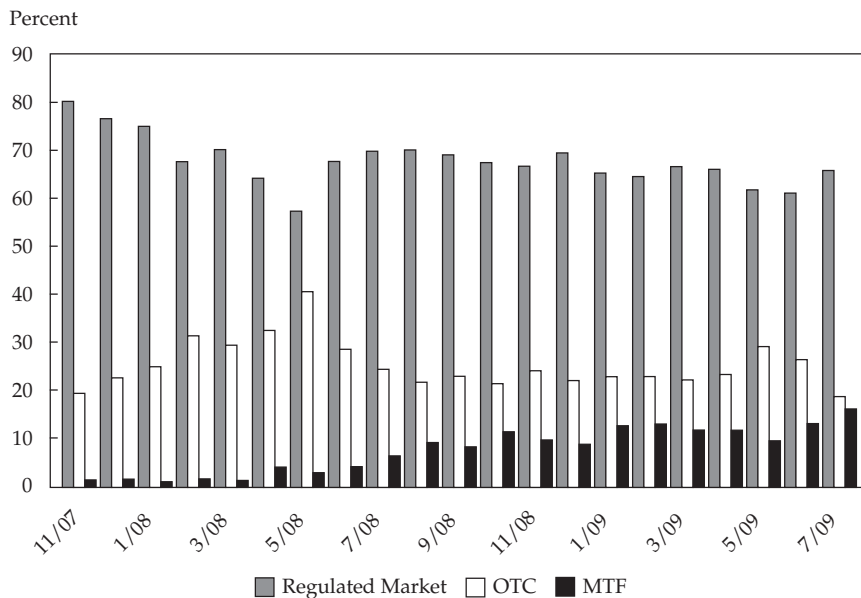
Figure 3



6.2.1.ii. France: CAC 40 Index

The market share of trading in French stocks broadly reflects the trends observed at the overall European level, as illustrated in **Figure 4**. The market share of MTFs has risen to just over 15 percent at the end of July 2009, whilst the share of regulated markets has fallen from 80 percent to approximately 65 percent. OTC volumes reported through Markit BOAT average one-quarter of total trading volumes over the period.

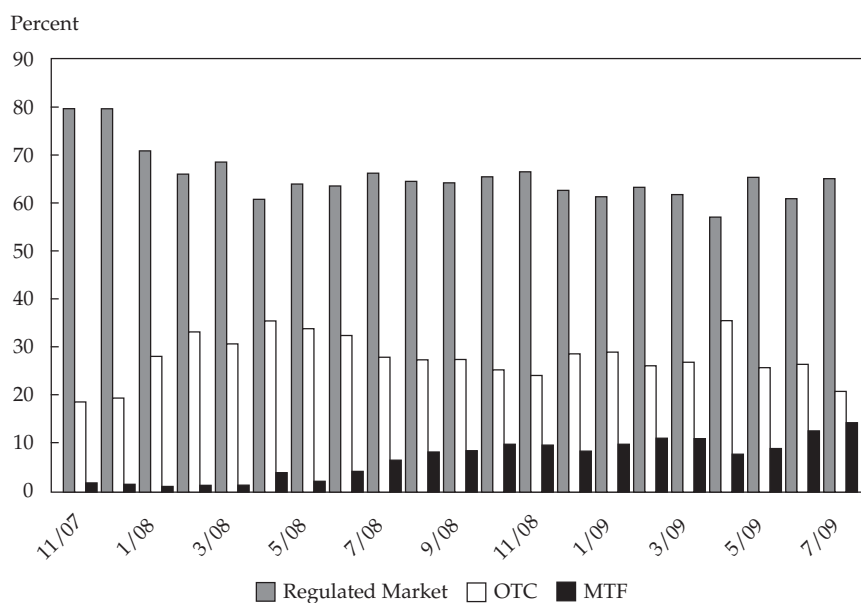
Figure 4



6.2.1.iii. Germany: Xetra Dax Index

German equities exhibit the same trends as French equities, as illustrated in **Figure 5**. Generally, market shares of the different categories of trading venues are broadly the same for Xetra Dax stocks as for French stocks in most months. The market share of MTFs reached 14 percent at the end of the review period, whilst regulated markets accounted for an average of 66 percent of trading volumes over the period.

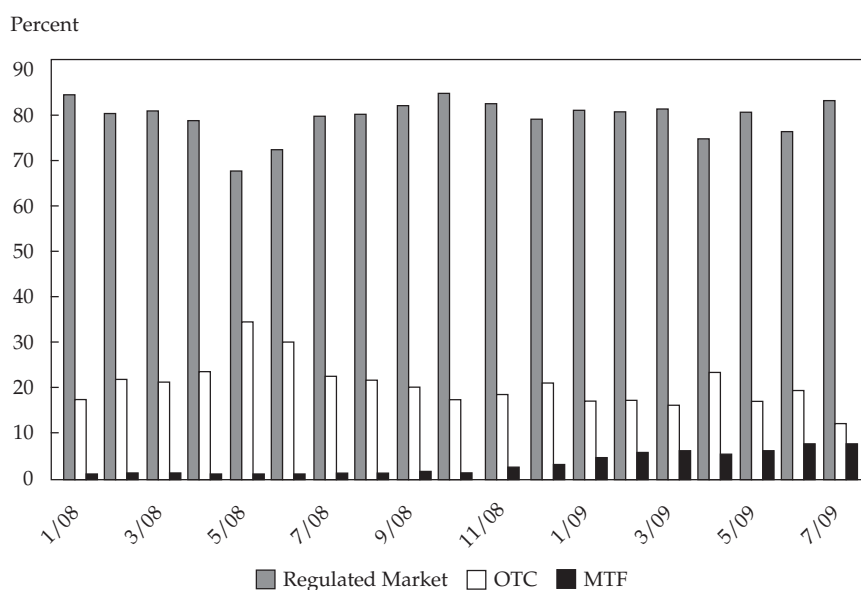
Figure 5



6.2.1.iv. Italy: FTSE MIB Index

Italian stocks, represented by the FTSE MIB Index, are less fragmented than those elsewhere, as illustrated in **Figure 6**.⁴¹ The market share of regulated markets has remained relatively stable, averaging 78 percent over the period. In contrast, the market share of MTFs is approximately half of the equivalent market share in French and German stocks, rising only to 7 percent of total trading volume by the end of the period. OTC volumes, whilst volatile, have decreased over the period.

Figure 6

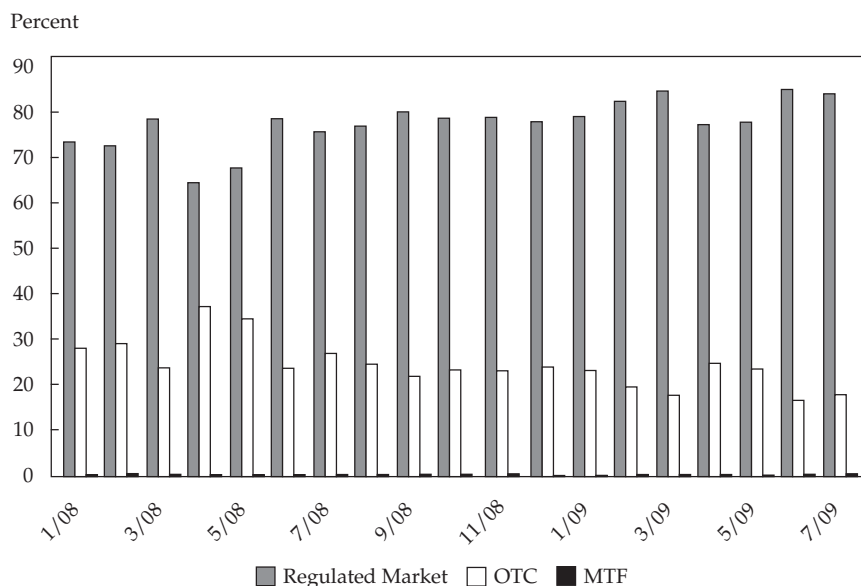


⁴¹ Data for November 2007 and December 2007 were not available for the FTSE MIB (formerly S&P MIB) and IBEX 35 indices. Figures 6 and 7 are therefore presented from January 2008 onwards.

6.2.1.v. Spain: IBEX 35 Index

Spanish stocks are the least fragmented amongst the major European markets, as demonstrated in **Figure 7**. Regulated markets continue to account for the dominant share of trading volumes, whilst MTFs account for less than 0.5 percent throughout the period. The market share of regulated markets has actually increased, from around 70 percent to 80 percent of total trading volumes.

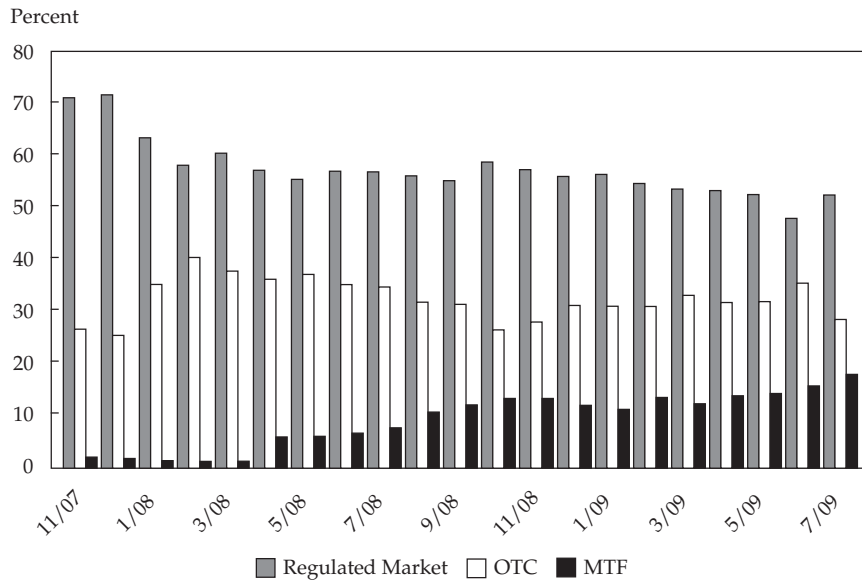
Figure 7



6.2.1.vi. United Kingdom: FTSE 100 Index

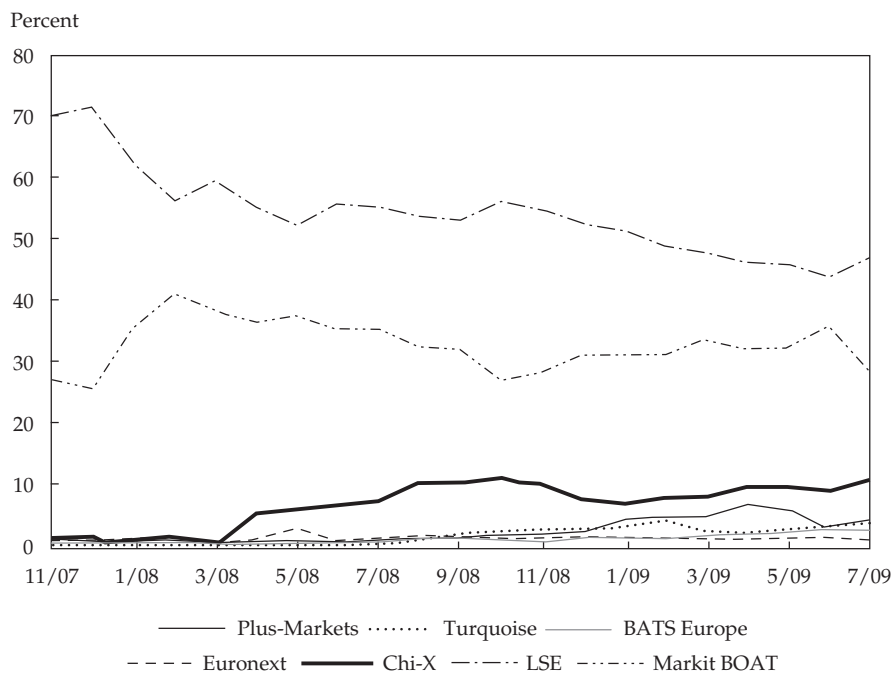
The United Kingdom is the most fragmented equity market, illustrated in **Figure 8**. This most likely reflects the fact that MTFs offer trading primarily in the largest, most liquid equities, many of which are listed in the United Kingdom. Moreover, the U.K. market is the largest in Europe by most measures and is therefore perceived as strategically important in the pursuit of market share. This is emphasized by the fact that many of the MTFs have located their operations in London.

Overall, the market share of regulated markets has declined by approximately 20 percent over the period, to account for approximately half of total trading volumes by July 2009. At the same time, MTFs have increased their market share from 1 percent to 18 percent. OTC volumes reported through Markit BOAT have fluctuated over the period and average around one-third of total trading volumes.



Disaggregating trading volumes by venue, it is evident that, despite the increasing market share of MTFs in the United Kingdom, only Chi-X has managed to establish a strong and stable share of trading volumes. This is illustrated in **Figure 9** which shows the market share of trading volumes for the seven largest trading venues in the United Kingdom.

Figure 9



6.2.1.vii. Individual volumes

The data presented in **Table A.1**, shown in Appendix A, illustrate that the market share trends observed in Figures 3 to 8 are broadly consistent with the changes in actual trading volumes amongst individual stocks.

A sample of 44 large companies domiciled in European Union countries⁴² has been used to examine average trading volumes in two equal time periods, pre- and post-MiFID implementation. Average volumes⁴³ for the primary listings of each security (namely, volumes traded on the respective primary exchanges) have decreased for around half the stocks sampled. Moreover, the greatest declines in average trading volumes on the primary exchanges relate to U.K. stocks—consistent with the United Kingdom being the most fragmented market.

Moreover, it appears that sectoral factors are significant in explaining the trends witnessed. Stocks that have experienced an increase in trading volumes primarily relate to companies in the banking sector, which has been at the centre of the financial crisis. We would expect trade volumes in these stocks to have significantly increased as investors have sought to materially change their exposures to the banking sector in the wake of systemic events.

The increase in volumes on the primary exchanges amongst banking stocks may also be indicative of counterparty considerations. In the midst of the financial crisis, when investor confidence has been severely damaged, it is possible that trades would migrate to the primary liquidity venues, as investors seek comfort that trades can be executed, cleared, and settled through established, integrated platforms.

6.2.2. Price Formation

This section examines three key measures of the quality of the price formation process: bid-ask spreads, volatility, and tests of the randomness of price movements.

The analysis is performed for a sample of 44 blue-chip European stocks, drawn from the constituents of the Dow Jones Stoxx 50 index, as identified in Section 6.2.1.vii. For comparability, each metric is examined over two equal time periods of 440 trading days prior to and post the implementation of MiFID on 1 November 2007.⁴⁴

The aim is to establish, first, whether any significant changes have occurred in the price formation process since the implementation of MiFID; and second, to assess the nature and extent of any such changes. In particular, we focus on whether the patterns observed correlate with the extent of fragmentation.

6.2.2.i. Bid-ask spreads

For each of the 44 stocks contained in our sample, the quoted half-spread⁴⁵ has been calculated for each trading day in the period under review, based on closing quotes.⁴⁶ The quoted half-spread is a measure of dispersion from the mid-price and reflects a measure of indirect trading costs incurred by buyers or sellers.

The weighted-average half-spread for the portfolio of 44 stocks has then been calculated on each day, in order to determine the aggregate trend in bid-ask spreads for the period under review. The weighted-average half-spread for the portfolio on any day t is given by

$$\sum_i \left(\frac{MV_{i,t}}{\sum_{i=1}^n MV_{i,t}} \right) \times \left(\frac{S}{2} \right)_{i,t},$$

⁴² The sample was drawn from a population represented by the Dow Jones Stoxx 50 Index, which comprises 50 blue-chip stocks from 18 European countries. Stocks from non-EU countries (such as Switzerland) were filtered out, leaving a sample of 44 stocks.

⁴³ Data sourced from FactSet.

⁴⁴ Period 1 spans from 2 February 2006 to 31 October 2007. Period 2 spans from 1 November 2007 to 31 July 2009.

⁴⁵ The quoted half-spread is measured by $(A - B)/2$; where A = quoted ask price, and B = quoted bid price. The spread has been measured in euros for all stocks for comparability across the sample, and is expressed in cents.

⁴⁶ The absolute value of the spread based on closing quotes is likely to be greater than the value based on average spreads through the trading day, given intra-day trading patterns and the level of activity around the close. However, it is the trend in spreads over time rather than the actual size of the spread that matters here.

where:

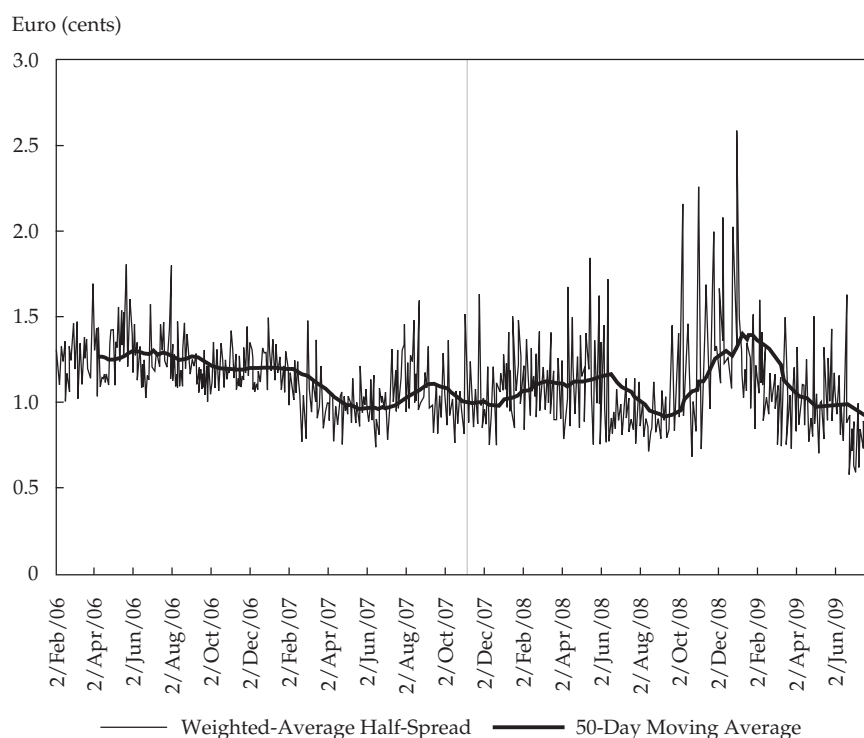
$MV_{i,t}$ = market value (in euros) of stock i on day t ;

$\left(\frac{S}{2}\right)_{i,t}$ = quoted half-spread for stock i on day t ; and

$n = 1, \dots, 44$ stocks.

The weighted-average half-spread for the portfolio is illustrated in **Figure 10**. The dividing line for the two periods represents the implementation of MiFID on 1 November 2007.

Figure 10



Sources: FactSet, CFA Institute calculations

On first inspection, we can see that bid-ask spreads followed a slight downward trend prior to the implementation of MiFID, with the 50-day moving average half-spread reaching approximately 1 cent by 1 November 2007. Spreads start to pick-up almost immediately post the implementation of MiFID, before drifting downwards again in the summer of 2008. Thereafter, a steep increase in spreads can be seen following the onset of the market crisis triggered by the default of Lehman Brothers in September 2008. The collapse in investor confidence and reduction in liquidity is manifested by the spread-widening in the fourth quarter of 2008, where the half-spread spikes above 2 cents. As markets have stabilised in 2009, and confidence has returned, spreads have trended downwards again, with the 50-day moving average half-spread drifting below 1 cent by the end of the period.

A striking feature of Figure 10 is the level of variability in bid-ask spreads between the two time periods. The half-spread ranges between 0.75 cents and 1.8 cents in Period 1, whereas in Period 2, the half-spread ranges from 0.6 cents to 2.6 cents, approximately double the range in Period 1. This is consistent with an approximate doubling in the variance of the half-spread, to 7.4 percent in Period 2 from 3.1 percent in Period 1. The difference is statistically significant.⁴⁷

It is likely that systemic factors (as opposed to MiFID) largely explain the higher variability in bid-ask spreads in the post-MiFID period, driven by the pattern of market events in the fourth quarter of 2008. However, by examining average spread levels for the two periods, the effects of market events can be smoothed out, enabling one to identify underlying trends in bid-ask spreads.

⁴⁷ Based on an F-test at the 1 percent level of significance.

In fact, average spreads have fallen slightly over the two periods. The mean half-spread for Period 1 is 1.15 cents, and for Period 2, it is 1.08 cents, a decline of 6 percent. The difference between the two means is statistically significant.⁴⁸ One possible explanation for the reduction in spreads could be competitive forces. Specifically, the existence of greater competition amongst trading venues, introduced under MiFID, may encourage liquidity suppliers to post narrower spreads to attract order flow.

The results are disaggregated in Appendix B, which shows the mean half-spreads (**Table B.1**) and variances (**Table B.2**), for the two periods, for each of the 44 stocks in the sample. Table B.2 illustrates the increase in variability of bid-ask spreads, where 35 stocks have experienced an increase in variance. Moreover, Table B.1 shows that 24 out of the 44 stocks have experienced a reduction in average spreads, 23 of which are statistically significant. Most notably, 13 U.K. stocks (out of a total of 14 in the portfolio) are contained within the sub-sample of 24 stocks that have experienced a fall in average spreads. Given that the United Kingdom is also the most fragmented market (see Figure 8), this lends some support to the notion that greater competition has a positive effect on bid-ask spreads.

Similarly, four out of the seven French stocks contained in the portfolio have experienced a decline in average spreads, the second highest number by country after the United Kingdom. The difference in average spreads is statistically significant for each of these four stocks, and importantly, statistically insignificant for the remaining three French stocks which experienced an increase in spreads. France is also the second most fragmented market amongst the countries studied, as illustrated in Section 6.2.1.⁴⁹

However, extrapolating this across the full sample, we are unable to reach a firm conclusion at the aggregate portfolio level. Specifically, formal tests for correlation between changes in average spreads and the extent of fragmentation yield inconclusive results. The difference in mean spreads (where statistically significant) between the two periods was ranked from largest to smallest, and compared against a ranking of fragmentation, based on the Fidessa Fragmentation Index (FFI).⁵⁰ The Spearman's rank correlation coefficient between the two sets of ranks returns a value of -0.2, which is not statistically significantly different from zero.⁵¹ This indicates that the relationship between bid-ask spreads and the extent of fragmentation is not consistent across countries and markets. Accordingly, we cannot draw any firm conclusions over the precise relationship between fragmentation and bid-ask spreads at the aggregate level.

In practice, it is likely that this relationship is obfuscated by other factors. For example, technological developments, which have decreased latency, may increase liquidity and thereby reduce dealers' inventory risk, resulting in narrower spreads. High-frequency trading techniques, such as algorithmic trading, can have a similar effect on spreads (a greater number of transactions means the same profits can be made from smaller spreads). Such high-frequency trading techniques are also consistent with higher variability in prices and spreads due to the greater number of transactions that can occur. These technological factors can influence spreads regardless of the extent of fragmentation in any given market. In short, it is difficult to isolate the effect of fragmentation alone on bid-ask spreads. However, the anecdotal evidence from the U.K. and French markets indicates that fragmentation is at least one factor related to the reduction in spreads in these markets.

⁴⁸ Based on a t-test at the 1 percent level of significance.

⁴⁹ The results for U.K. and French stocks in the sample are broadly representative of the wider populations of U.K. and French stocks. Over 90 percent of FTSE 100 stocks have experienced a reduction in average bid-ask spreads between the two review periods; and over 75 percent of CAC 40 stocks have experienced a reduction in average bid-ask spreads.

⁵⁰ The FFI assigns a unique fragmentation score to each stock (see <http://fragmentation.fidessa.com/>). FFI figures were taken as at the end of the review period (31 July 2009).

⁵¹ Based on a t-test at the 5 percent level.

6.2.2.ii. Volatility

The volatility of stock prices can be examined as a proxy to gauge market liquidity and investor confidence.

Volatility, measured by the standard deviation of daily price changes, has been calculated for each of the 44 stocks sampled and compared between the two review periods.

The standard deviation of price changes has also been calculated at the aggregate portfolio level to establish the overall trend for the period. For each trading day t , the weighted-average price for the portfolio is given by

$$\sum_i \left(\frac{MV_{i,t}}{\sum_{i=1}^n MV_{i,t}} \right) \times P_{i,t},$$

where:

$MV_{i,t}$ = market value (in euros) of stock i on day t ;

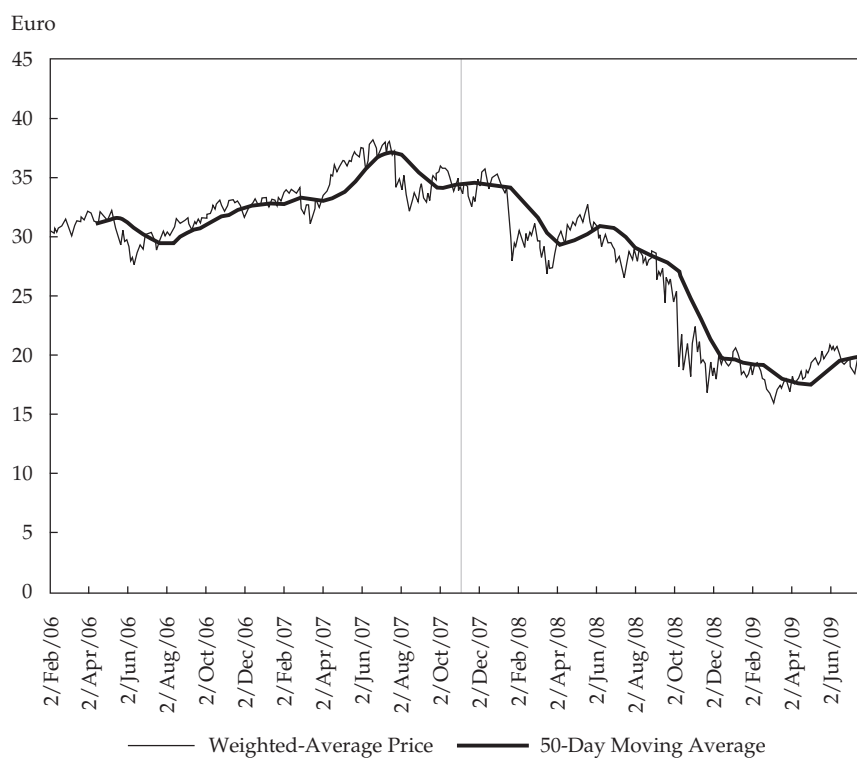
$P_{i,t}$ = price of stock i on day t , expressed in euros; and

n = 1, ..., 44 stocks.

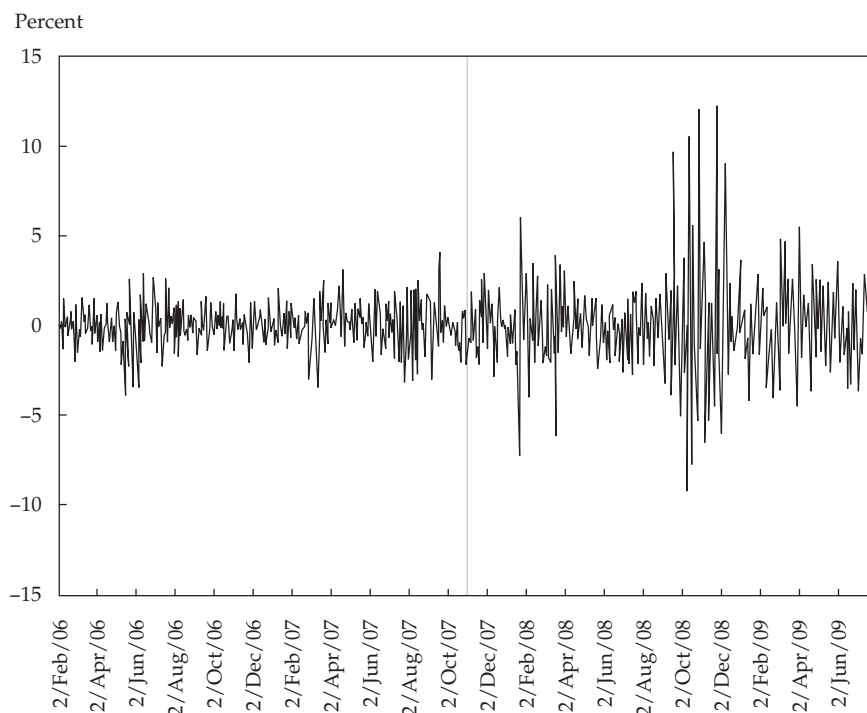
The standard deviation has then been calculated for the daily percentage change in the weighted-average price of the portfolio, as well as for each of the individual stocks.

The price level and daily percentage change in prices at the aggregate portfolio level are illustrated in **Figure 11** and **Figure 12**, respectively. The dividing line represents the implementation of MiFID on 1 November 2007, splitting the data into two equal periods of 440 trading days.

Figure 11



Sources: FactSet, CFA Institute calculations



Sources: FactSet, CFA Institute calculations

It is most evident from Figure 12 that volatility is significantly greater in Period 2 compared with Period 1. The daily percentage change in the weighted-average price for the portfolio of 44 stocks ranges between approximately -3 percent and +4 percent in the pre-MiFID implementation period, indicating relatively stable price formation. In Period 2, however, the range is from approximately -9 percent to +12 percent, a trebling of the range in the first period. In formal terms, the standard deviation of daily price changes is 1.12 percent in Period 1 and 2.40 percent in Period 2, which is a statistically significant difference.⁵²

Consistent with Figure 10, most of the variability in stock prices occurs in the fourth quarter of 2008, reflecting the exacerbation of market confidence stemming from the collapse of Lehman Brothers. The trend illustrated suggests that market-wide factors related to the financial crisis are most likely to explain the higher volatility in stock prices in the second period, rather than specific factors related to the implementation of MiFID.

Examination of the standard deviation of daily price changes amongst the individual stocks sampled supports this assertion. **Table C.1** in Appendix C shows that all stocks have experienced an increase in volatility between the two periods, all of which are statistically significant.⁵³ In over two-thirds of the cases (31 stocks), the standard deviation has more than doubled.

Moreover, unlike bid-ask spreads, there is no apparent relation between country of domicile, or company size, and changes in volatility. Rather, the changes appear to be sectoral: most of the largest increases in standard deviation—for example, the top 13—relate to companies in the banking, mining, and industrial metals sectors. These sectors have been most impacted by the financial crisis, which stemmed from systemic effects related to the banking sector and a commodity price bubble, suggesting that the increase in volatility is more attributable to recent financial and economic events as opposed to fragmentation or other issues related to market structure.

Formal tests of correlation between changes in volatility and the extent of fragmentation appear to support this notion. The difference in volatility between the two periods was ranked from largest to smallest, and (analogous to bid-ask spreads) was compared with a ranking of fragmentation, based on the Fidessa Fragmentation Index (FFI). The Spearman's

⁵² Based on an F-test at the 1 percent level.

⁵³ Based on an F-test at the 1 percent level.

rank correlation coefficient between the two sets of ranks returns a value of -0.3⁵⁴ (a negative relationship implies that the most fragmented stocks are among those stocks that have experienced the smallest increase in volatility). Whilst the correlation coefficient is statistically significant⁵⁵, the strength of the relationship is relatively weak. Hence, we cannot conclude that there is a clear relationship between fragmentation and volatility. However, the sign of the coefficient at least suggests that fragmentation is not positively associated with increases in volatility.

Note also that those sectors that have experienced the greatest increase in volatility (e.g., the banking sector) are broadly the same as those sectors that have experienced the largest increases in on-exchange trading volumes, as noted in Section 6.2.1.vii and Appendix A. In practice, it seems likely that, for these sectors, systemic considerations have driven both the increase in volatility and the migration of trade volumes to the primary exchanges. Either way, we can conclude that fragmentation is unrelated to *increases* in volatility.

Another important observation from Figure 12 is that changes in prices appear to be mean reverting; we can see that daily changes in prices are reasonably equally dispersed either side of 0 percent in both periods. This implies that the price formation process is first-difference stationary, an important property that has implications for the efficiency of price formation. We consider this concept further in Section 6.2.2.iii.

6.2.2.iii. Randomness of price movements

The efficiency of price formation is representative of the effectiveness of market structure in providing the foundations for an efficiently functioning market. Moreover, market efficiency is a key objective of MiFID. It is therefore expedient to assess the efficiency of market prices before and after the implementation of MiFID.

The efficiency of price formation can be measured by the extent to which stock prices follow random movements. The objective is not to explicitly model the process of price formation; rather, it is simply to establish whether there are any material changes in the randomness of price movements between the two review periods.

It follows from the efficient markets hypothesis (EMH)⁵⁶ that if markets are efficient, prices can be characterised by a random walk (or variants thereof).⁵⁷ The simple random walk model can be expressed as follows:

$$P_t = \gamma P_{t-1} + \varepsilon_t \quad (1)$$

where ε_t is an error term and $\gamma = 1$ (a unit root). This implies that the change in prices between day t and $t-1$ is a random error.

The existence of a unit root implies that the price formation process captured by Equation 1 is non-stationary (there is no constant, finite mean). Statistical inference based on the above specification is therefore not valid. However, we can re-specify the model by subtracting P_{t-1} from both sides as follows:

$$\begin{aligned} P_t - P_{t-1} &= (\gamma - 1)P_{t-1} + \varepsilon_t \\ \Delta P_t &= \delta P_{t-1} + \varepsilon_t \end{aligned} \quad (2)$$

Equation 2 is first-difference stationary, implying that the change in prices is a mean-reverting process. In fact, we can witness this from Figure 12, which in effect is a plot of ε_t , expressed in percentage terms.⁵⁸ The daily change in prices is symmetrically distributed around zero in both periods, indicating that the error term is approximately normally distributed in both periods.

⁵⁴ The correlation coefficient ranges between -1 and +1.

⁵⁵ Based on a t-test at the 5 percent level.

⁵⁶ Put simply, the EMH states that prices fully reflect all available information without leaving further room for abnormal gains.

⁵⁷ The random-walk model can also be specified with or without a constant (a 'drift') or a deterministic time trend (using time, t , as an independent variable).

⁵⁸ Solving Equation 1 or Equation 2 for ε_t gives $\varepsilon_t = P_t - P_{t-1}$ for $\gamma = 1$.

Significantly, we can see from Figure 12 that there is no visible evidence of serial correlation⁵⁹ in either period; price changes appear random and uncorrelated with previous price changes.⁶⁰ On first inspection, this is a good indication that price formation is equally efficient over the two review periods. The random walk model appears to fit the price formation process observed.

More formally, we can use Equation 2 to draw statistical inferences over the price formation process. As noted above, if prices are efficient—characterised by the random walk model—then a unit root must exist, meaning that $\delta = (\gamma - 1) = 0$. We can therefore test for the existence of a unit root to make inferences over the efficiency, or randomness, of price formation.⁶¹

Regressions were run for Equation 2 for each of the two equal time periods of 440 trading days prior to and post the implementation of MiFID. The change in prices (the dependent variable) and the one-day lagged price level (the explanatory variable) are representative of the weighted-average price of the portfolio of 44 stocks, taken from Section 6.2.2.ii.

Selected regression output is shown in Appendix D. The regression output includes the values of the test statistic and associated critical values for the unit root hypothesis test on the coefficient δ . The unit root test is based on the null hypothesis of $H_0: \delta = 0$ (meaning that a unit root exists) versus the alternative of $H_1: \delta < 0$.

The results shown in Appendix D illustrate that we cannot reject the null hypothesis in either time period. This suggests that price movements are random (or efficient) both prior to and post the implementation of MiFID.

To test the robustness of these findings, further regressions were run to include additional explanatory variables including a constant term, a time trend, and higher-order lagged operators of the dependent variable. Augmented Dickey-Fuller tests generally yield the same results, namely, that we cannot reject the null hypothesis.⁶²

It is also important to establish whether the efficiency of price formation is consistent between the two review periods. Specifically, we can perform a hypothesis test on the difference between the coefficient δ between the two time periods.⁶³ The test is based on the null hypothesis that the coefficients are equal between the two time periods ($H_0: \delta^{\text{Period1}} - \delta^{\text{Period2}} = 0$).

Calculation of the test-statistic results in a value which is not statistically significant at the 5 percent level. Accordingly, the null hypothesis cannot be rejected. This implies that there is no structural break in the time series.

Put differently, we can conclude that price movements must be approximately equally random over the two periods; there is no evidence to suggest that price formation is any more, or any less, efficient since the implementation of MiFID. This would at least suggest that fragmentation has not had any material impact on market efficiency.

⁵⁹ The correlation of the error term with itself in successive time periods.

⁶⁰ This is validated by tests for serial correlation in the residuals (ϵ_t) estimated from the regression specified by Equation 2. The null hypothesis of no serial correlation in the residuals cannot be rejected.

⁶¹ A test for the existence of a unit root under the model specification given by Equation 2 is referred to as a Dickey-Fuller test. We can augment the model to include a constant (drift) and a deterministic time trend. Under such specifications, the test is referred to as the Augmented Dickey-Fuller test.

⁶² Based on the 5 percent significance level. The results are robust to all augmented specifications of the model run for Period 2. For Period 1, if a constant (drift term) is added we can reject the null hypothesis of a unit root. However, by building in additional lagged operators of the dependent variable, and/or a deterministic time trend, the coefficient δ ceases to be statistically significant; meaning that the null hypothesis cannot be rejected.

⁶³ The test is commonly referred to as the Chow test.

7. Conclusions and Policy Considerations

Taking into consideration the findings of the survey along with the results from the data analyses, it is evident that the equity trading landscape is complex. Trends in fragmentation, costs, and price formation at the aggregate level are not always definitive, owing to the variation in trends observed at the micro-level. The inherent complexity of the market environment, coupled with the myriad of factors that influence the aspects of microstructure under consideration, mean that it is difficult to firmly establish the impact of fragmentation since the implementation of MiFID.

Nevertheless, the evidence presented would at least suggest that fragmentation has not had a detrimental effect on markets overall. Indirect trading costs, measured by average bid-ask spreads, have slightly fallen at the aggregate level. In particular, amongst U.K. stocks, the fall in average bid-ask spreads is well pronounced. The United Kingdom is also the most fragmented market. Price formation is also equally efficient (at least in the informational sense), as measured by the randomness of price movements, both prior to and post MiFID implementation, suggesting that fragmentation has not materially impaired the process of price discovery. Stock price volatility has increased, although this can be at least partially explained by systemic events. Indeed, the relationship between volatility and the extent of fragmentation is relatively weak; if anything, it is negative. Put differently, there is no evidence of positive correlation between increases in volatility and the extent of fragmentation.

Moreover, the absence of negative findings to coincide with the incidence of increasing fragmentation indicates that market structure is functioning reasonably well. In essence, transparency, and the ability of brokers to seek out, connect, and route orders to the venues offering the best prices—the foundations of centralised markets—must be functioning relatively well. At the overall level, it appears that fragmentation has not materially impaired the interaction of orders across markets and trading venues, judged by the trends observed in the price formation process.

In short, competition amongst trading venues has not been detrimental for markets.

However, improvements are needed. One noted downside of fragmentation is that it has created difficulties in trade reporting, indicated by 68 percent of survey respondents. There is a risk that the greater number of platforms, combined with the latitude afforded to investment firms in fulfilling their trade reporting obligations, may lead to poorer quality post-trade data. Furthermore, fragmentation may have increased the cost of data access, as indicated by 64 percent of survey respondents.

Dark pools are also of concern to certain investors and merit further investigation. Notably, approximately 70 percent of CFA Institute survey respondents believe that such platforms are problematic for price discovery and market volatility.

Most significantly, CFA Institute survey respondents support the implementation of a mandated consolidated tape for European equity markets. Whilst certain market participants are likely to have sufficient size and scale to obtain a complete picture of the markets—and the results of the data analyses, highlighted above, are certainly consistent with this assertion at the overall level—it is also evident that certain investors find it costly or prohibitive to access multiple sources of data and/or liquidity. In this respect, the market may not be considered a level playing field. Comments from investors responding to the survey lend further support to this view.

Accordingly, the Centre recommends that European authorities pursue the introduction of a formal consolidated data system for quote and trade data for European equity markets, introduced under MiFID in a properly calibrated fashion, to improve overall market transparency, efficiency, and fairness.

The infrastructure supporting the creation of a consolidated quote and trade system (collectively referred to as a ‘tape’) would require the creation of a central data repository⁶⁴ for quote and trade information throughout EU equity markets. The tape would act as the central access point to that data, providing fair, consistent access to prices for investors, and providing an accurate and clear view of market activity for all participants. Within this framework, existing data vendors

⁶⁴ CFA Institute has consistently called for a central data repository to enhance transparency. A summary of related positions is set out in http://www.cfainstitute.org/centre/topics/markets/official/trade_reporting.html.

would likely continue to offer consolidated data on a commercial basis, with different service offerings providing data in varying levels of depth to serve the varying needs of investors.

A consolidated tape would improve the quality of data, facilitate the accomplishment and measurement of best execution, and level the playing field amongst market participants.

Such a system would further improve market microstructure and contribute to an efficiently functioning single market for equities.

Appendix A

Average trading volumes on the primary exchanges for the sample of 44 stocks are presented in **Table A.1**. Average volumes have been obtained for two equal time periods of 440 trading days prior to and post MiFID implementation on 1 November 2007.⁶⁵

U.K. stocks have witnessed the largest falls in on-exchange trading volumes. Note also that sectoral factors are equally significant, with most financial stocks experiencing an increase in average trading volumes. This owes to the significance of the financial sector in relation to market events during the review period.

Table A.1

	Country	Stock	Average Volume Period 1 ('000s)	Average Volume Period 2 ('000s)	Change
1	GB	VODAFONE GROUP	349,934.60	184,205.80	-47.4%
2	GB	DIAGEO	15,412.03	9,345.73	-39.4
3	GB	BP	92,231.64	56,934.82	-38.3
4	GB	GLAXOSMITHKLINE	24,437.78	16,035.92	-34.4
5	GB	ROYAL DUTCH SHELL A	7,661.65	5,063.48	-33.9
6	GB	BG GROUP	16,151.62	11,114.79	-31.2
7	GB	TESCO	41,851.46	29,248.66	-30.1
8	GB	ASTRAZENECA	8,703.49	6,401.53	-26.4
9	GB	RIO TINTO	12,940.87	9,562.67	-26.1
10	IT	ASSICURAZIONI GENERALI	9,586.57	7,084.48	-26.1
11	GB	BRITISH AMERICAN TOBACCO	8,226.11	6,110.61	-25.7
12	FI	NOKIA	35,526.47	27,107.79	-23.7
13	GB	BHP BILLITON	24,374.28	19,342.99	-20.6
14	SE	ERICSSON LM B	28,493.51	23,357.46	-18.0
15	DE	E.ON	12,940.53	11,137.07	-13.9
16	GB	ANGLO AMERICAN	9,187.76	8,231.50	-10.4
17	FR	TOTAL	10,667.39	9,720.59	-8.9
18	DE	SAP	8,314.48	7,622.66	-8.3
19	ES	TELEFONICA	57,004.93	52,580.34	-7.8
20	IT	ENI	29,339.75	27,759.18	-5.4
21	NL	PHILIPS ELECTRONICS	7,629.10	7,226.50	-5.3
22	DE	BAYER	5,643.81	5,411.55	-4.1
23	DE	DEUTSCHE TELEKOM	30,290.96	29,119.33	-3.9
24	DE	BASF	6,434.27	6,511.79	1.2
25	FR	SANOFI-AVENTIS	4,923.20	5,017.43	1.9

⁶⁵ Period 1 spans from 2 February 2006 to 31 October 2007. Period 2 spans from 1 November 2007 to 31 July 2009.

26	DE	SIEMENS	6,326.17	6,521.84	3.1
27	GB	HSBC	56,742.13	59,270.78	4.5
28	FR	FRANCE TELECOM	12,369.51	13,048.39	5.5
29	NL	UNILEVER NV	9,347.66	9,944.28	6.4
30	DE	DAIMLER	8,315.58	9,438.35	13.5
31	DE	ALLIANZ	3,598.16	4,229.72	17.6
32	IT	INTESA SANPAOLO	63,424.54	75,234.49	18.6
33	ES	IBERDROLA	36,767.87	45,576.68	24.0
34	ES	BANCO BILBAO VIZCAYA ARGENTARIA	43,380.16	55,262.97	27.4
35	FR	BNP PARIBAS	4,675.71	6,207.09	32.8
36	ES	BANCO SANTANDER	79,153.26	111,648.72	41.1
37	FR	AXA	9,196.23	13,101.35	42.5
38	GB	BARCLAYS	48,333.13	77,204.00	59.7
39	DE	DEUTSCHE BANK	5,107.80	8,724.31	70.8
40	NL	ING GROUP	10,631.27	18,428.48	73.3
41	IT	UNICREDIT	123,784.03	219,447.90	77.3
42	FR	GROUP SOCIETE GENERALE	2,724.64	5,311.14	94.9
43	NL	ARCELORMITTAL	2,963.60	7,612.59	156.9
44	FR	GDF SUEZ	1,552.82	4,275.69	175.3

Sources: FactSet, CFA Institute calculations

Appendix B

Bid-ask spreads for the sample of 44 stocks are illustrated below; **Table B.1** shows average spreads, and **Table B.2** shows the variance of spreads.

The tables display, respectively, the mean and variance of the half-spread based on closing quotes, for the two periods under review. Mean half-spreads are expressed in euro cents. The stocks are sorted by country classification, shown in the first column on the left. The differences between the two means and variances, respectively, are highlighted in bold where statistically significant.⁶⁶

Table B.1

Country	Market Value 31 July 09 (EUR millions)	Stock	Mean Half-Spread: Period 1	Mean Half-Spread: Period 2	Difference	Difference +/-
DE	28,292.15	DEUTSCHE BANK	2.36	1.78	(0.58)	–
DE	34,449.55	DAIMLER	1.56	1.37	(0.19)	–
DE	39,208.27	DEUTSCHE TELEKOM	0.57	0.47	(0.10)	–
DE	31,351.06	ALLIANZ	3.35	3.46	0.10	+
DE	40,452.88	SAP	1.03	1.27	0.24	+
DE	51,195.39	SIEMENS	1.91	2.28	0.37	+
DE	53,146.56	E.ON	0.92	1.33	0.42	+
DE	32,293.71	BASF	1.08	1.60	0.53	+
DE	35,608.37	BAYER	1.41	1.98	0.57	+
ES	43,873.00	BANCO BILBAO VIZCAYA ARGENTARIA	0.58	0.54	(0.05)	–
ES	82,860.95	BANCO SANTANDER	0.51	0.50	(0.00)	–
ES	82,125.72	TELEFONICA	0.56	0.58	0.01	+
ES	31,618.99	IBERDROLA	0.22	0.51	0.29	+
FI	34,977.82	NOKIA	0.54	0.62	0.08	+
FR	27,268.57	GROUP SOCIETE GENERALE	3.69	1.63	(2.06)	–
FR	60,463.05	SANOFI-AVENTIS	2.07	1.47	(0.60)	–
FR	92,287.05	TOTAL	1.71	1.16	(0.55)	–
FR	55,045.73	BNP PARIBAS	2.29	1.93	(0.36)	–
FR	30,982.53	AXA	0.78	0.83	0.04	+
FR	46,376.83	FRANCE TELECOM	0.60	0.65	0.05	+
FR	60,569.32	GDF SUEZ	1.45	1.66	0.21	+
GB	69,710.56	GLAXOSMITHKLINE	1.47	0.82	(0.65)	–
GB	38,985.15	BARCLAYS	0.72	0.28	(0.44)	–
GB	29,711.27	ANGLO AMERICAN	1.59	1.18	(0.40)	–
GB	108,973.88	BP	0.74	0.39	(0.34)	–

⁶⁶ Based on a t-test for the mean and an F-test for the variance, both at the 5 percent level.

GB	122,799.55	HSBC	0.64	0.35	(0.29)	–
GB	47,462.10	ASTRAZENECA	1.47	1.19	(0.28)	–
GB	65,177.19	ROYAL DUTCH SHELL A	1.51	1.23	(0.28)	–
GB	43,373.62	BRITISH AMERICAN TOBACCO	1.47	1.23	(0.24)	–
GB	44,340.22	RIO TINTO	1.21	0.99	(0.22)	–
GB	75,428.96	VODAFONE GROUP	0.30	0.08	(0.22)	–
GB	34,081.62	TESCO	0.37	0.18	(0.18)	–
GB	40,337.44	BHP BILLITON	1.21	1.16	(0.06)	–
GB	27,417.40	DIAGEO	0.88	0.83	(0.05)	–
GB	39,261.21	BG GROUP	0.74	1.06	0.33	+
IT	34,432.55	UNICREDIT	0.22	0.35	0.13	+
IT	30,956.38	INTESA SANPAOLO	0.23	0.61	0.38	+
IT	65,407.51	ENI	0.54	2.53	1.98	+
IT	23,449.63	ASSICURAZIONI GENERALI	0.58	3.26	2.68	+
NL	39,413.09	ARCELORMITTAL	2.65	1.18	(1.47)	–
NL	18,564.21	ING GROUP	0.78	0.79	0.02	+
NL	32,871.33	UNILEVER NV	0.72	1.06	0.35	+
NL	15,558.59	PHILIPS ELECTRONICS	0.74	1.27	0.53	+
SE	20,458.40	ERICSSON LM B	1.68	0.50	(1.17)	–

Sources: FactSet, CFA Institute calculations

Table B.2

Country	Market Value 31 July 09 (EUR millions)	Stock	Variance Half-Spread: Period 1	Variance Half-Spread: Period 2	Difference	Difference +/-
DE	28,292.15	DEUTSCHE BANK	3.36	2.25	(1.10)	–
DE	34,449.55	DAIMLER	1.61	1.09	(0.52)	–
DE	39,208.27	DEUTSCHE TELEKOM	0.03	0.06	0.03	+
DE	31,351.06	ALLIANZ	6.94	8.38	1.44	+
DE	40,452.88	SAP	0.65	1.01	0.36	+
DE	51,195.39	SIEMENS	2.29	2.85	0.57	+
DE	53,146.56	E.ON	0.49	0.90	0.41	+
DE	32,293.71	BASF	0.74	1.86	1.12	+
DE	35,608.37	BAYER	1.14	6.76	5.61	+
ES	43,873.00	BANCO BILBAO VIZCAYA ARGENTARIA	0.08	0.06	(0.02)	–
ES	82,860.95	BANCO SANTANDER	0.02	0.03	0.01	+
ES	82,125.72	TELEFONICA	0.04	0.09	0.05	+
ES	31,618.99	IBERDROLA	0.03	0.03	0.00	+

FI	34,977.82	NOKIA	0.03	0.09	0.06	+
FR	27,268.57	GROUP SOCIETE GENERALE	6.55	6.06	(0.49)	-
FR	60,463.05	SANOFI-AVENTIS	1.56	2.90	1.34	+
FR	92,287.05	TOTAL	1.28	2.46	1.18	+
FR	55,045.73	BNP PARIBAS	2.48	11.35	8.87	+
FR	30,982.53	AXA	0.32	1.59	1.27	+
FR	46,376.83	FRANCE TELECOM	0.07	0.80	0.73	+
FR	60,569.32	GDF SUEZ	1.64	3.49	1.86	+
GB	69,710.56	GLAXOSMITHKLINE	0.00	0.12	0.12	+
GB	38,985.15	BARCLAYS	0.00	0.03	0.03	+
GB	29,711.27	ANGLO AMERICAN	0.00	0.04	0.03	+
GB	108,973.88	BP	0.00	0.04	0.04	+
GB	122,799.55	HSBC	0.00	0.03	0.03	+
GB	47,462.10	ASTRAZENECA	0.00	0.04	0.03	+
GB	65,177.19	ROYAL DUTCH SHELL A	0.59	0.01	(0.58)	-
GB	43,373.62	BRITISH AMERICAN TOBACCO	0.00	0.01	0.01	+
GB	44,340.22	RIO TINTO	0.00	0.02	0.02	+
GB	75,428.96	VODAFONE GROUP	0.01	0.00	(0.01)	-
GB	34,081.62	TESCO	0.00	0.01	0.01	+
GB	40,337.44	BHP BILLITON	0.12	0.05	(0.07)	-
GB	27,417.40	DIAGEO	0.09	0.12	0.03	+
GB	39,261.21	BG GROUP	0.00	0.09	0.09	+
IT	34,432.55	UNICREDIT	0.00	0.13	0.13	+
IT	30,956.38	INTESA SANPAOLO	0.01	0.51	0.50	+
IT	65,407.51	ENI	0.02	9.58	9.56	+
IT	23,449.63	ASSICURAZIONI GENERALI	0.08	16.81	16.73	+
NL	39,413.09	ARCELORMITTAL	9.26	1.47	(7.79)	-
NL	18,564.21	ING GROUP	0.33	1.91	1.58	+
NL	32,871.33	UNILEVER NV	0.17	2.13	1.96	+
NL	15,558.59	PHILIPS ELECTRONICS	0.27	3.96	3.69	+
SE	20,458.40	ERICSSON LM B	0.70	0.05	(0.65)	-

Sources: FactSet, CFA Institute calculations

Appendix C

The volatility of stock prices, measured by the standard deviation of daily price changes, is presented in **Table C.1**. The standard deviation is shown for each of the 44 stocks sampled, for the two periods under review. The table shows the difference in volatility between the two periods, sorted from highest to lowest. The difference in standard deviation between the two periods is statistically significant for all stocks.⁶⁷

Table C.1

	Country	Market Value 31 July 09 (EUR millions)	Stock	Std. Dev. Daily Price Change: Period 1	Std. Dev. Daily Price Change: Period 2	Difference	Difference +/-
1	GB	38,985.15	BARCLAYS	1.59%	6.99%	5.39%	+
2	NL	18,564.21	ING GROUP	1.26	5.94	4.69	+
3	DE	28,292.15	DEUTSCHE BANK	1.40	4.70	3.30	+
4	GB	44,340.22	RIO TINTO	2.31	5.45	3.14	+
5	FR	30,982.53	AXA	1.54	4.67	3.13	+
6	IT	34,432.55	UNICREDIT	1.39	4.39	2.99	+
7	FR	27,268.57	GROUP SOCIETE GENERALE	1.58	4.37	2.79	+
8	FR	55,045.73	BNP PARIBAS	1.49	4.16	2.67	+
9	NL	39,413.09	ARCELORMITTAL	2.24	4.86	2.63	+
10	GB	29,711.27	ANGLO AMERICAN	2.38	4.99	2.62	+
11	DE	31,351.06	ALLIANZ	1.36	3.97	2.61	+
12	GB	122,799.55	HSBC	0.92	3.45	2.53	+
13	IT	30,956.38	INTESA SANPAOLO	1.33	3.63	2.30	+
14	DE	34,449.55	DAIMLER	1.63	3.72	2.09	+
15	ES	82,860.95	BANCO SANTANDER	1.26	3.32	2.07	+
16	GB	40,337.44	BHP BILLITON	2.35	4.37	2.03	+
17	ES	43,873.00	BANCO BILBAO VIZCAYA ARGENTARIA	1.23	3.15	1.92	+
18	DE	32,293.71	BASF	1.17	3.03	1.85	+
19	GB	39,261.21	BG GROUP	1.64	3.46	1.82	+
20	DE	51,195.39	SIEMENS	1.57	3.39	1.82	+
21	IT	65,407.51	ENI	1.09	2.87	1.78	+
22	FR	60,569.32	GDF SUEZ	1.40	3.12	1.72	+
23	FI	34,977.82	NOKIA	1.67	3.36	1.68	+
24	DE	53,146.56	E.ON	1.43	3.01	1.58	+
25	ES	31,618.99	IBERDROLA	1.54	3.10	1.56	+
26	GB	65,177.19	ROYAL DUTCH SHELL A	1.14	2.62	1.48	+
27	FR	92,287.05	TOTAL	1.21	2.68	1.46	+
28	SE	20,458.40	ERICSSON LM B	2.07	3.52	1.44	+
29	GB	108,973.88	BP	1.19	2.63	1.43	+

⁶⁷ Based on an F-test at the 1 percent level.

30	NL	15,558.59	PHILIPS ELECTRONICS	1.49	2.89	1.40	+
31	GB	43,373.62	BRITISH AMERICAN TOBACCO	1.11	2.45	1.34	+
32	GB	34,081.62	TESCO	1.27	2.55	1.28	+
33	DE	39,208.27	DEUTSCHE TELEKOM	1.21	2.43	1.22	+
34	GB	27,417.40	DIAGEO	0.92	2.13	1.21	+
35	FR	60,463.05	SANOFI-AVENTIS	1.22	2.42	1.20	+
36	GB	75,428.96	VODAFONE GROUP	1.64	2.83	1.19	+
37	NL	32,871.33	UNILEVER NV	1.12	2.20	1.08	+
38	GB	47,462.10	ASTRAZENECA	1.28	2.35	1.07	+
39	GB	69,710.56	GLAXOSMITHKLINE	1.11	2.16	1.05	+
40	DE	35,608.37	BAYER	1.54	2.54	1.01	+
41	DE	40,452.88	SAP	1.39	2.38	0.99	+
42	ES	82,125.72	TELEFONICA	1.14	1.98	0.85	+
43	IT	23,449.63	ASSICURAZIONI GENERALI	1.26	2.07	0.81	+
44	FR	46,376.83	FRANCE TELECOM	1.30	2.03	0.73	+

Sources: FactSet, CFA Institute calculations

Appendix D

Selected regression output for the Dickey-Fuller (DF) test is presented below. The price level for the portfolio of 44 stocks is shown as 'index_p' in the regression output. Similarly, 'D.index_p' is the change in the price level (the dependent variable). L1 represents the one-period lagged value of the price level; LD represents the difference in the lagged value of the price level, and so forth.

The selected regression output is shown for Period 1 (2 February 2006 to 31 October 2007) and Period 2 (1 November 2007 to 31 July 2009), respectively. For each period, the regression specified by Equation 2 is shown first, followed by selected augmented specifications.

The test-statistic for the hypothesis test on the coefficient, δ , is shown alongside selected critical values for the (Augmented) Dickey-Fuller test.

Period 1

Dickey-Fuller test for unit root		Number of obs = 439			
Interpolated Dickey-Fuller					
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value		
Z(t) 0.447	-2.580	-1.950	-1.620		
D.index_p	Coef.	Std.Err.	t	P> t	[95% Conf. Interval]
index_p	.0002372	.0005306	0.45	0.655	-.0008057 .0012801
L1.					

Augmented Dickey-Fuller test for unit root		Number of obs = 438			
Z(t) has t-distribution					
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value		
Z(t) -1.628	-2.335	-1.648	-1.284		
p-value for Z(t) = 0.0521					
D.index_p	Coef.	Std.Err.	t	P> t	[95% Conf. Interval]
index_p					
L1.	-.0122792	.007541	-1.63	0.104	-.0271004 .0025421
LD.	-.0467371	.0479121	-0.98	0.330	-.140905 .0474309
_cons	1.215123	.7293306	1.67	0.096	-.2183276 2.648573

Dickey-Fuller test for unit root		Number of obs = 439			
Interpolated Dickey-Fuller					
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value		
Z(t) -2.672	-3.982	-3.422	-3.130		
MacKinnon approximate p-value for Z(t) = 0.2479					
D.index_p l	Coef.	Std.Err.	t	P> t	[95% Conf. Interval]
index_p l					
L1. l	-.0327497	.0122572	-2.67	0.008	-.0568402 -.0086592
LD. l	.0013548	.0006601	2.05	0.041	.0000574 .0026522
_cons l	2.890566	1.072262	2.70	0.007	.7831218 4.99801

Period 2

Dickey-Fuller test for unit root		Number of obs = 440			
Interpolated Dickey-Fuller					
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value		
Z(t) -1.518	-2.580	-1.950	-1.620		
D.index_p l	Coef.	Std.Err.	t	P> t	[95% Conf. Interval]
index_p l					
L1. l	-.0015388	.0010139	-1.52	0.130	-.0035316 .0004539

Augmented Dickey-Fuller test for unit root		Number of obs = 440			
Z(t) has t-distribution					
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value		
Z(t) -1.525	-2.335	-1.648	-1.283		
p-value for Z(t) = 0.0640					
D.index_p l	Coef.	Std.Err.	t	P> t	[95% Conf. Interval]
index_p l					
L1. l	-.0067257	.0044106	-1.52	0.128	-.0153943 .0019429
LD. l	-.0795026	.0475486	-1.67	0.095	-.172955 .0139498
_cons l	.3968227	.3337863	1.19	0.235	-.2592034 1.052849

Dickey-Fuller test for unit root		Number of obs = 440			
Interpolated Dickey-Fuller					
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value		
Z(t) -1.862	-3.982	-3.422	-3.130		
MacKinnon approximate p-value for Z(t) = 0.6740					
D.index_p l	Coef.	Std.Err.	t	P> t	[95% Conf. Interval]
index_p l					
L1. l	-.0200736	.0107791	-1.86	0.063	-.0412588 .0011117
LD. l	-.001976	.0014723	-1.34	0.180	-.0048697 .0009178
_cons l	1.820413	1.099279	1.66	0.098	-.3401173 3.980944

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