

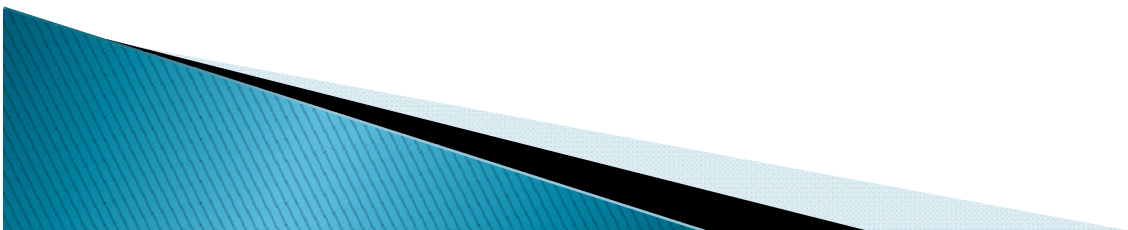
The impact of market fragmentation on European Stock Exchanges

Simone Francesco Fioravanti CONSOB– Markets Division

Monica Gentile CONSOB – Research Division

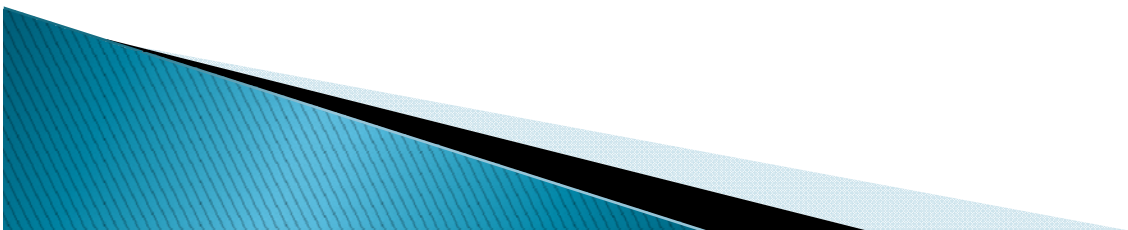
10 February 2011

Opinion expressed in this paper are exclusively those of the authors and do not necessarily reflect those of CONSOB.



Overview

- ▶ MiFID has enhanced competition among trading venues. Economic theory points out both benefits and disadvantages of stock market fragmentation.
- ▶ Review of the literature: empirical analyses on the effects of fragmentation on stock markets.
- ▶ Description of the plan of the research:
 - aims
 - financial indicators
 - econometric models
- ▶ Analysis of results



MiFID: new rules for the stock market

MiFID is designed to promote an integrated and harmonised European financial trading landscape. Three types of trading venues are allowed to compete for equity order flow: regulated markets, multilateral trading facilities (MTFs) and systematic internalizers.

Market access: MiFID abolishes the option for a so-called “concentration rule”, meaning that orders must be executed on regulated market.

Transparency requirements: MiFID requires regulated markets and MTFs to publish best bid and ask prices along with the number of shares quoted at these prices on a continuous basis. Post-trade requirements include the time of execution, the execution price, and the associated trading volume.

Best execution: intermediaries (e.g. investment firms, brokers) that execute orders on behalf of clients have to set out a best execution policy. Best execution under MiFID is defined by taking into account multiple factors, such as price, costs, speed, likelihood of execution and settlement, or order size.

Market fragmentation in Europe

In Europe (Dow Jones Eurostoxx600), the share of trading on multilateral trading facilities (MTFs) was approximately 21% at the end 2011.

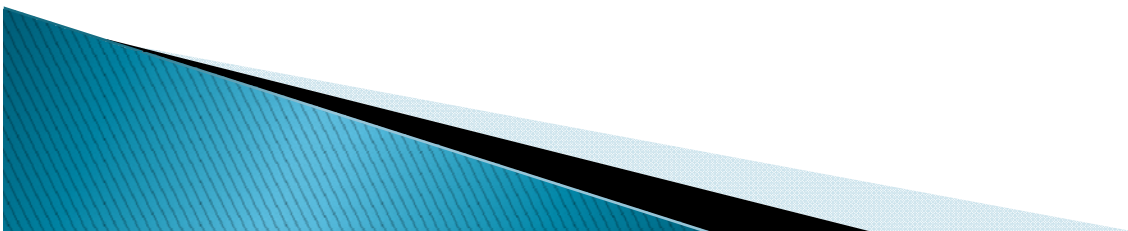
Fragmentation level deeply varies among European stock markets: it is high for the stocks in the FTSE100 index and approximately null for stocks in the IBEX35 index.

First reason of the success of MTFs (in some countries) is that trading commissions required by MTFs are significantly lower than traditional stock exchange's ones in particular for investors who provide liquidity in the system.



Factors explaining the success of MTFs

- ▶ Technological facilities as Smart Order Routing Technology create a virtual link among trading venues.
- ▶ MTFs have adopted advanced technological facilities which reduce the **latency** (average time between the transmission of an order and its execution). This type of technological innovation attracts high frequency traders (HFTs).
- ▶ Alternative venues that trade the same stock but with different cost/rebate models are an ideal ground for **high frequency trading**. Algorithmic trading affects the level of market fragmentation as computer programs allow investors to find the best liquidity in the market by comparing the order books of individual venues.

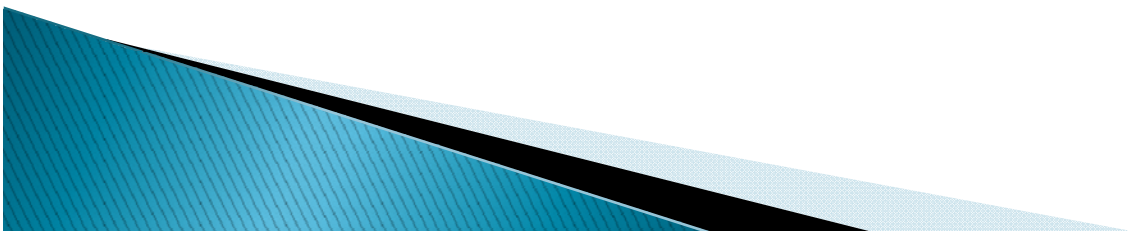


Technological innovation, algorithmic trading and market fragmentation are connected

Algorithmic trading is related to liquidity as it can reduce implicit transaction costs by splitting up a large order into many smaller ones.

Computer Program are also used to identify deviations from the efficient share price, by quickly trading on different exchange platforms.

Menkveld (2011): *Electronic trading reduces search cost, reduces the entry barrier for new markets and thus creates real competition among multiple markets.* The success of Chi-X is explained also by the participation of a large HFT.



Regarding market fragmentation, economic theory puts on evidence both disadvantages...

Reduction of economy of scale

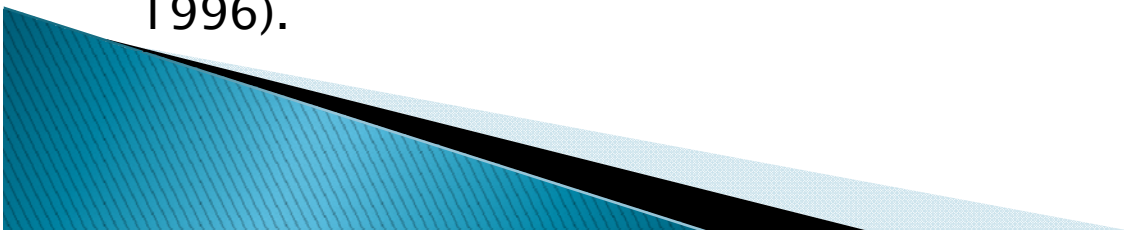
The marginal cost of a trade decreases with the quantity of orders executed in the market: a consolidated market enjoys economies of scale.

Reduction of network externalities

A market becomes more attractive as the number of traders increases. When order flow becomes fragmented, the probability of finding a counterparty could diminish. Consequently, execution probabilities could be lowered.

Information asymmetry

In fragmented markets, informed investors can leverage their informational advantage (Chowdry and Nanda, 1991). Adverse selection costs increase with the number of markets listing an asset. When a new market opens for a stock, it may skim the least informed and harm the liquidity of primary market (Easley, Kiefer and O'Hara, 1996).



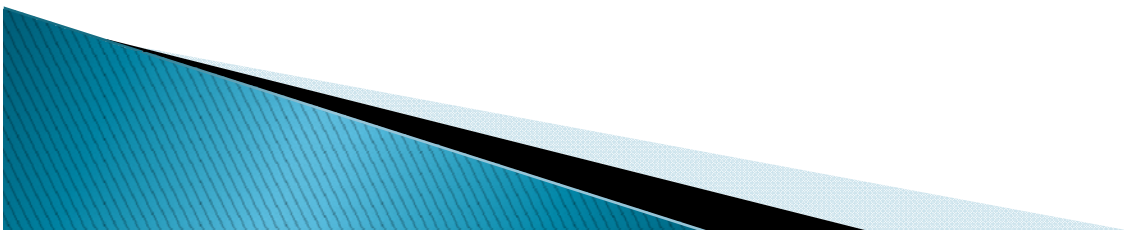
...and benefits

Competition

Stoll (2003): “...*fragmentation is just another word for competition*”. Different types of trading venues are allowed to compete for order flow with the traditional market. This is expected to reduce the monopoly power of the traditional market and to lower transaction costs.

Transparency requirements

Information should be accessed faster and cheaper, hence efficiency should improve.



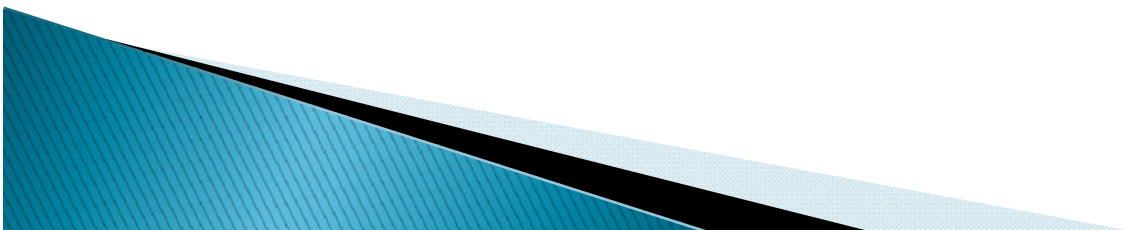
Benefits

Diversification of the needs of different categories of investors

Fragmentation often arises between trading systems that use different mechanisms and thereby addresses the needs of different categories of investors (Harris, 1993). The ability to serve different clienteles and satisfy diverse trading needs is one of the positive aspects of fragmentation (Hendershott and Mendelson, 2000).

Technological innovation is fostered

The development of smart order routing can increase the probability of finding an exchange counterpart even in fragmented markets.



Financial literature: which is the impact of fragmentation on stock market?

- ▶ Bennett and Wei (2006) show that stocks switching from the Nasdaq fragmented environment to the more consolidated NYSE structure experience an increase of spreads.
- ▶ Foucalt and Menkveld (2008) : analysis of the competition between Euronext and London Stock Exchange in the Dutch stock market. Positive effect of fragmentation on the liquidity level.
- ▶ O'Hara and Yee (2011) analyse US stock market after Regulation National Market System and find that fragmentation increases liquidity and improves market information efficiency (mandatory consolidated tape).

Empirical analysis on the impact of fragmentation on stock markets after MiFID

Degryse, Jong and Kervel (2011)	Dutch stocks	Global /local liquidity	Blue chips /small stocks	Positive effect for blue chips and negative effect for small caps
Gresse (2011)	FTSE100, Cac40, SBF120	Global/local liquidity	Blue chips and medium caps	Positive effect for blue chips negative effect for medium caps (only regarding depth)
Riordan, Storkenmaier, Wagener (2010–2011)	FTSE100	Price discovery	Blue chips	Chi-X contributes significantly to the price discovery process.
Gomber, Gsell and Lutat (2011)	Eurostoxx	Global/local liquidity	Blue chips	Positive effect

The plan of the research:

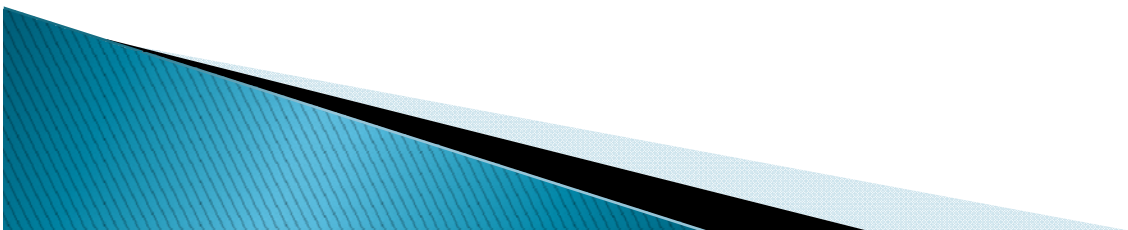
Aims

Impact of market fragmentation on European stock exchanges

Focus on:

a) Average trends in Europe and blue chips: our sample is composed of stocks included in the Eurostoxx50

b) The impact of fragmentation on stock exchanges (local liquidity)



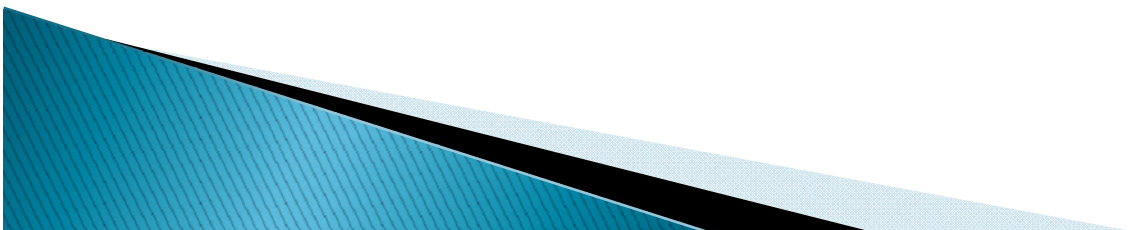
The plan of the research

Aims

c) empirical analysis on the impact of fragmentation on liquidity, information efficiency and price discovery

d) take into consideration methodological and statistical issues

e) test the robustness of results by applying a variety of empirical approaches



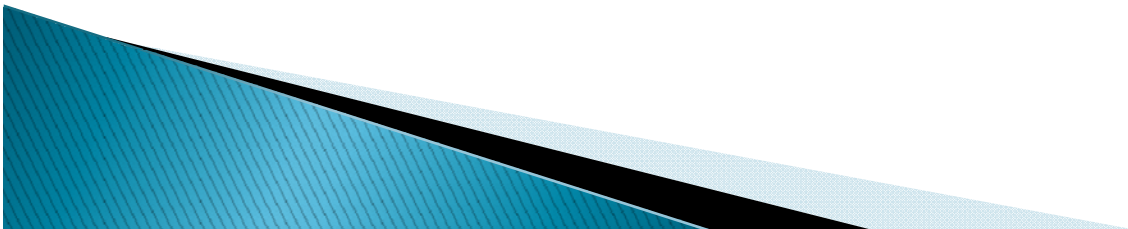
Financial indicators

Fragmentation index

The level of fragmentation is computed as the inverse of the Herfindhal concentration index, that is for stock i :

$$F_i = \frac{1}{N \sum_{j=1}^N q_{i,j}^2}$$

where $q_{i,j}$ is the share of trading volume on exchange platform j . This indicator ranges from 1 (in case of concentration of all the trading on 1 trading venue) and N (in case of equidistribution of trading among N platforms).



“ILLiquidity” indicators

Relative quoted spread

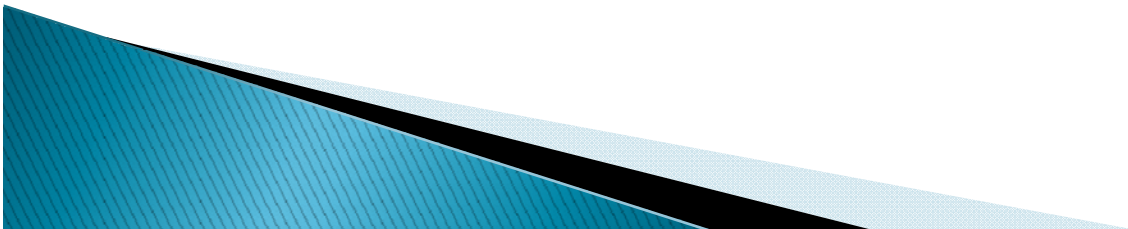
$$\frac{(ask_{i,t} - bid_{i,t})}{\frac{(bid_{i,t} + ask_{i,t})}{2}} * 100$$

that is a measure of transaction costs.

Price impact indicator

$$\frac{|r_{i,t}|}{trading_volume_{i,t}}$$

that measures the strength of the relation between size of trading and returns.

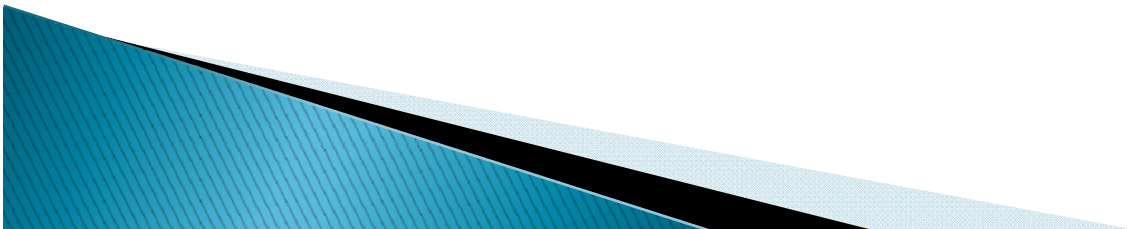


Liquidity indicator

Book depth

$$D_{i,t} = \frac{ask_{i,t} + bid_{i,t}}{2} * (quantity_ask_{i,t} + quantity_bid_{i,t})$$

where $quantity_ask_{i,t}$ and $quantity_bid_{i,t}$ are the quantities of shares available for exchange corresponding to the best bid and the best ask at time t .



Indicators of market information “in”efficiency

R²delay indicator; Hou and Moskowitz (2005)

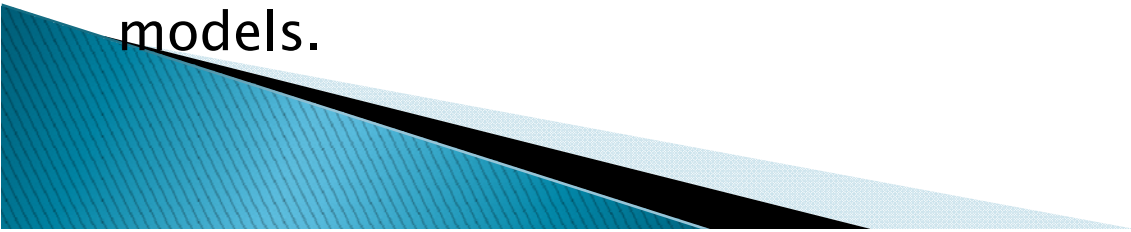
It is based on the estimation of two models:
a restricted one

$$r_{i,t} = a_i^R + b_i^R r_{m,t} + \varepsilon_{i,t}$$

and an extensive one

$$r_{i,t} = a_i^E + b_{i,0}^E r_{m,t} + b_{i,1}^E r_{m,t-1} + b_{i,2}^E r_{m,t-2} + \varepsilon_{i,t}$$

The indicator is based on the ratio between the coefficient of determinations of respectively the restricted and the extensive models.

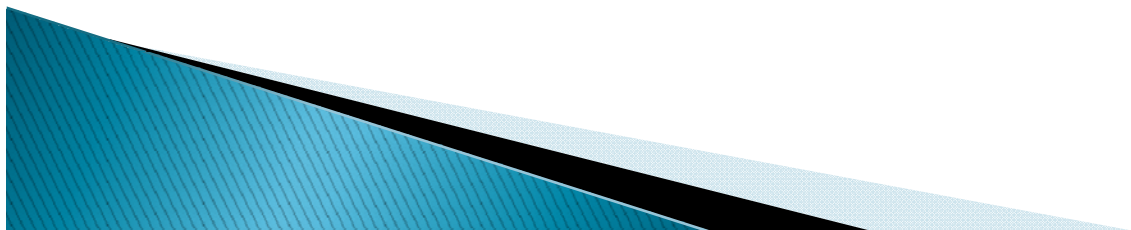


Variance ratio indicator; Lo and Mac Kinley (1988)

It is based on the ratio between the 30 minute variance and the 15 minute variance.

$$VR_{i,t} = \left| \left(\frac{\text{var}_{i,t}^{30\text{min}}}{2 * \text{var}_{i,t}^{15\text{min}}} \right) - 1 \right|$$

Under the hypothesis of market efficiency, returns are not serially correlated (weak information efficiency) and the variance additivity rule should be verified: the 30 minute variance should be approximately equal to two times 15 minute variance.



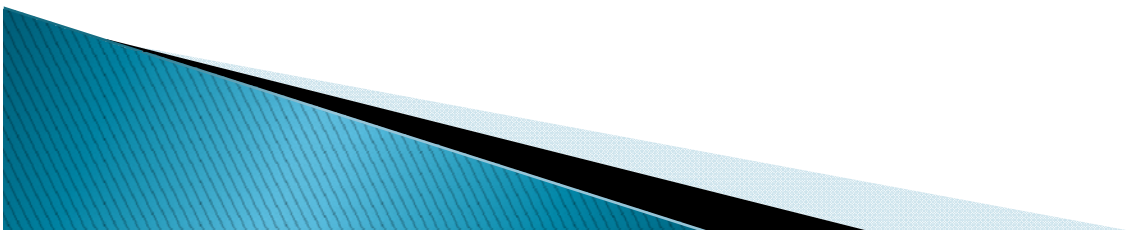
To sum up

Indicators	Daily data	High frequency data
Relative quoted spread	Yes	Yes
Price impact	Yes	No
Book Depth	No	Yes
R^2 delay	Yes	No
Variance ratio	No	Yes

Econometric models methodological issues

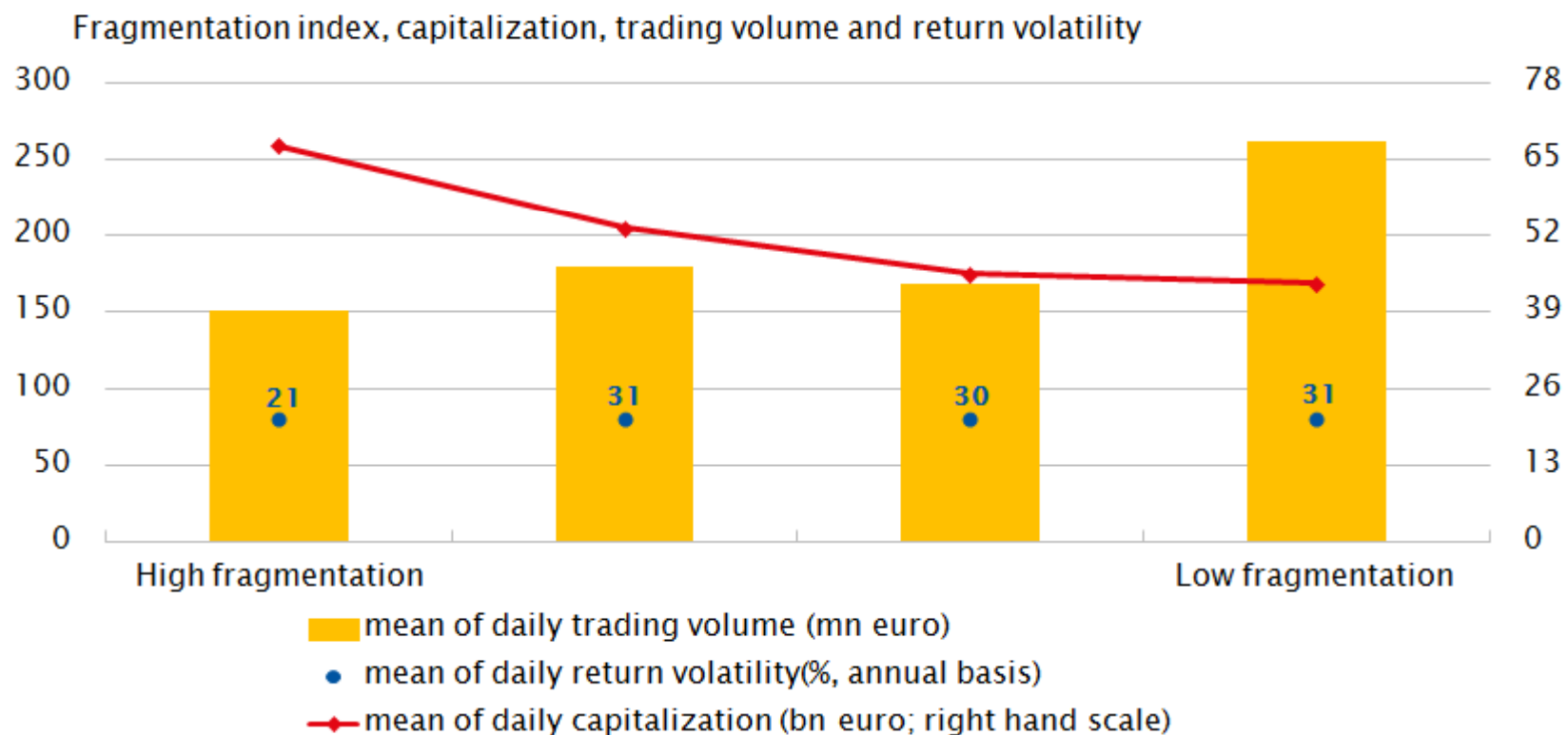
- a) Exactly identify the effects of market fragmentation without confusing them with shocks which influence the financial system as a whole: correct selection of explicative variables

- b) Endogeneity of the fragmentation variable (some explicative variables of liquidity and information efficiency influence also the level of market fragmentation)



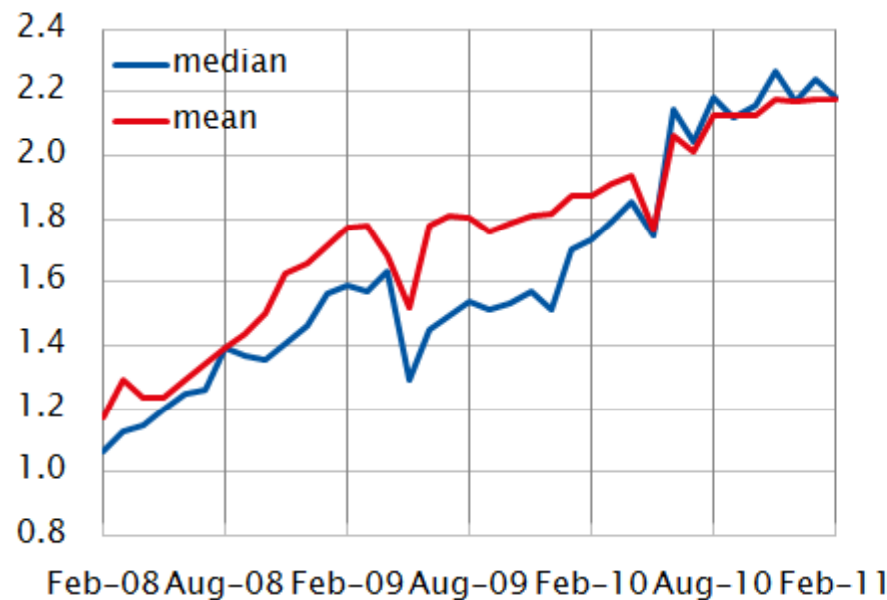
A descriptive analysis for the endogeneity issue

The sample of stocks is divided on the basis of the distribution of the fragmentation index (quartiles). More fragmented stocks are characterized by a higher level of capitalization, lower trading volume (on primary exchange) and lower volatility

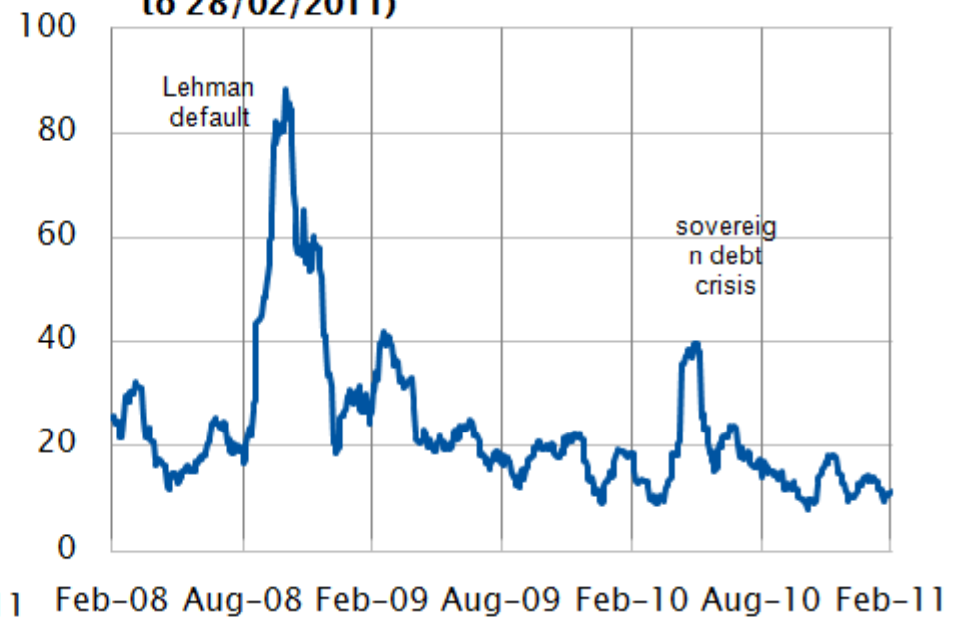


...the higher the volatility the lower the level of fragmentation

fragmentation index
(monthly data; february 2008–february 2011)



daily historical volatility time series
(%, annual basis; daily data from 28/02/2008 to 28/02/2011)



First model : “difference in difference”

Meyer (1995); Bertrand, Duflo and Mullainathan (2003), Petrella (2009)

Counterfactual logic assumption

Comparison between fragmented and not fragmented shares
(*control sample*)

Intuition...

If after MiFID adoption the liquidity of the control sample varied in the same way as the liquidity of fragmented stocks there would not be an identifiable “market fragmentation’s impact”

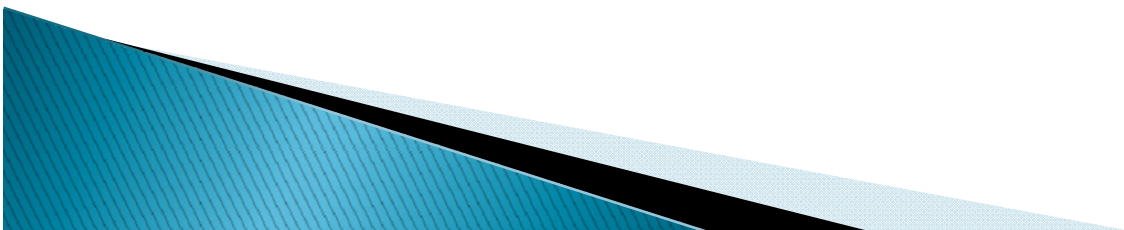
However...

Spanish stocks are almost not fragmented (*control sample*), while English stocks tend to be significantly fragmented.



Difference in difference methodology compares fragmented (FTSE100) and non fragmented stocks (IBEX35) by taking into consideration also other dissimilarities (capitalization, volatility, trading volume).

The impact of fragmentation is implicitly measured by finding **residual differences**, between fragmented and not fragmented stocks, which are not due to other factors (market conditions, exogenous shocks, capitalization, volatility, trading volume).



Difference in difference method

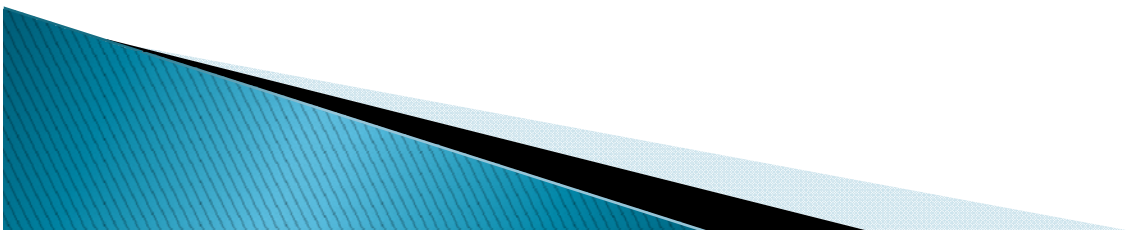
	Relative quoted spread	Price impact	R^2 delay
Market (FTSE100 or IBEX35)	0.017*	0.007	-0.040
Period (2007 or 2010)	-0.088***	0.005	-0.180***
Market *Period	0.005	-0.033***	0.165***
Volatility	0.166***	0.204***	0.027
Log(Cap)	-0.029***	-0.028***	-0.043
Log(trading volume)	-0.026***	-0.037***	-0.020
Price ⁻¹	0.016	-0.009	-
Constant	0.766***	0.648***	0.831*
R ²	0.7	0.7	0.3

Heckman selection model to make our results more robust

In this case the relation between market fragmentation, capitalisation and volatility is explicitly taken into consideration.

The model is composed of two equations with the following dependent variables:

- 1) the probability that a share is fragmented
- 2) the level of liquidity; in this second equation the impact of fragmentation is explicitly measured.



Heckman selection model

	Relative quoted spread	Depth	Variance ratio
Fragmentation $(1 - q^{SE})$	-0.035***	5.257***	0.352***
Volatility	0.001***	0.070***	0.0001
Mills ratio	0.051***	-1.407***	0.098***
R ²	0.9	0.5	0.9

To sum up.... models

	“difference in difference” method	Heckman selection model
Endogeneity	The effect of fragmentation is <u>implicitly</u> measured	The effect of fragmentation is <u>explicitly</u> measured (2 equations model)
Effect of other shocks	Temporal dummy variables	Temporal dummy variables
Periods of time	2007 and 2010	September 2010–February 2011
Indicators	Relative quoted spread Price impact R^2 delay	Relative quoted spread Book depth Variance ratio
Frequency of the data (indicators)	Daily	High frequency

....indicators

Indicators	Sign of the indicator's variation	Effect on the market
Relative quoted spread	+ / -	Less / more liquidity
Price impact	+ / -	Less / more liquidity
Book Depth	+ / -	More / less liquidity
R^2 delay	+ / -	Less / more efficiency
Variance ratio	+ / -	Less / more efficiency

....results

Indicators	“difference in difference”	Heckman selection model	Effect on the market
Relative quoted spread (illiquidity indicator)	Not significant	Significant and negative	Not significant effect or more liquidity
Price impact (illiquidity indicator)	Significant and negative	–	More liquidity
Book Depth	–	Significant and positive	More liquidity

...results

Indicators	Difference in difference	Heckman	Effect on the market
R^2 delay	Significant and positive	–	Less efficiency
Variance ratio	–	Significant and positive	Less efficiency

Price discovery: which trading venues leads the other?

Hasbrouck model (1995)

The most important assumption is that differences between equilibrium efficient price and trade prices are temporary: in the long run, all prices (on different trading venues) of the same stock should converge to a unique efficient price.

$$Dp_{i,k}^{SE} = a_1 \left(p_{i,k-1}^{SE} - p_{i,k-1}^{Chi-X} \right) + \sum_{j=1}^J g_{i,j} Dp_{i,k-j}^{SE} + \sum_{j=1}^J d_{i,j} Dp_{i,k-j}^{Chi-X}$$

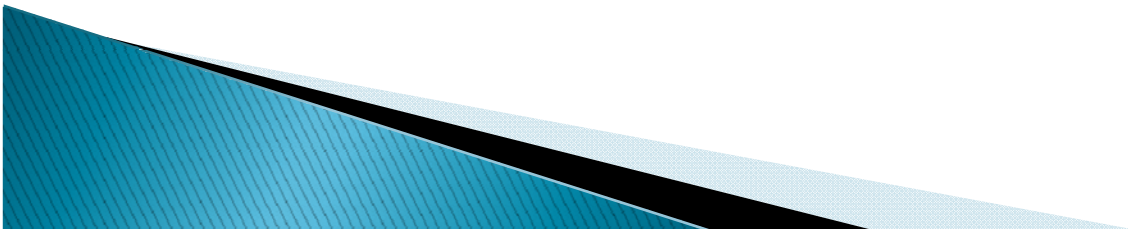
$$Dp_{i,k}^{Chi-X} = a_2 \left(p_{i,k-1}^{SE} - p_{i,k-1}^{Chi-X} \right) + \sum_{j=1}^J z_{i,j} Dp_{i,k-j}^{SE} + \sum_{j=1}^J f_{i,j} Dp_{i,k-j}^{Chi-X}$$

Cointegration

The price dynamic progressively corrects the gap $(p_{i,k-1}^{SE} - p_{i,k-1}^{ChiX})$.

This model allows to compare the speed of convergence (α) to the long run equilibrium price in different trading venues, by computing so-called “Gonzalo–Granger” statistic:

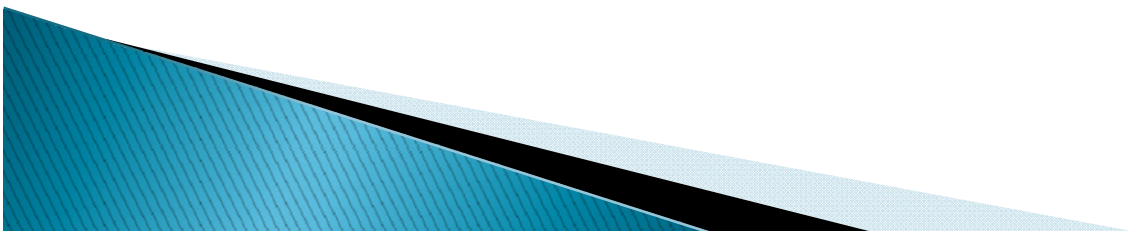
$$\frac{\alpha_2}{\alpha_2 - \alpha_1}$$



Results

Estimation results put on evidence that in 46% of the cases, stock exchanges maintain a leading role in the price discovery process, in 32% of the cases Chi-X is the leading trading venue.

The 88% of the shares for which Chi-X is the leading market is characterized by a high or medium-high level of fragmentation. The 83% of the shares for which stock exchange has a leading role in the price discovery process is, instead, characterized by a low or medium-low level of fragmentation.



Conclusions

Empirical analysis results are that fragmentation does not have negative effects on the liquidity, but it seems to reduce price information efficiency. Chi-X contributes significantly to the price discovery process of most fragmented stocks.

MiFID Review

- ▶ Increase of the liquidity level. Can it be due to high frequency traders?
- ▶ Reduction of information efficiency: strictly connected to the lack of a consolidated tape?
- ▶ Chi-X contributes significantly to the price discovery process. Is it necessary to increase level playing field between stock exchanges and MTFs?

