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Trading Mechanisms and Market Quality: Evidence from the London Stock Exchange

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Abstract
Over the last years we have witnessed sweeping changes in trading systems all over the world. Those changes provided academics with an opportunity to look into the microstructure of different markets. Most empirical work in the area has concentrated on comparing changes in liquidity, volatility, trading volume and asymmetric information under different trading settings. Informational efficiency and spread sensitivity to volatility has been neglected however. This paper looks into informational efficiency and spread sensitivity to volatility under different trading settings namely a dealership, an order driven market and a hybrid market. We use FTSE100 and FTSE250 stocks as our sample. The evidence shows that order driven markets respond faster to information compared to dealerships and that spread is more sensitive to volatility in a dealership than in an order driven market. The degree of informational efficiency as well as spread sensitivity to volatility is the same between a dealership and a hybrid market.
Keywords: London Stock exchange, SEAQ, SETS, SETSmm, informational efficiency, spread sensitivity, volatility

Introduction

In the last few years, there has been a race between stock exchange markets all around the world to modernize their trading processes. This came as a response to growing competition among stock exchange markets to attract more and more customers. Three basic models of trading mechanisms are applied in today's exchanges, continuous quote driven systems where dealers post bid quotes and ask quotes before order submission, order driven systems where traders submit orders before prices are determined and single call auctions where orders are batched and executed at discrete points in time. This study will concentrate on comparing market quality achieved with respect to informational efficiency and spread sensitivity to volatility by changing from one primary trading mechanism to the other, employing different closing price formations algorithms each time with reference to FTSE100 and FTSE250 stocks.

The number of changes that have occurred around the world do not indicate that a consensus has been reached as to which trading mechanism is the best or at least the most popular. Actually the issue of the best trading mechanism with respect to informational efficiency and spread sensitivity to volatility is far from being resolved. The London Stock Exchange replaced SEAQ (dealer market) with SETS (order-driven) for FTSE100 stocks and SEAQ (dealer market) with SETSmm (hybrid) for FTSE250 stocks. NASDAQ has introduced public limit orders competing with market makers' quotes following allegations of market markers' collusion to maintain high bid-ask spreads (Christie & Schultz, 1994; Christie et al, 1994). Obviously those three examples indicate a change from quote driven markets (dealerships) to pure order driven markets or hybrids. In France (NSC) and Germany (XETRA), market makers were introduced to provide additional liquidity to already electronic continuous auction markets indicating a change from order driven systems to hybrids. In addition continuous trading for less liquid stocks in the French CAC system and in German XETRA was replaced with call auctions. At the same time stocks listed on the French Nouveau Marche were transferred from a call market to an electronic continuous auction system. The last two incidents indicate movements in completely different directions (Theissen, 2000). Obviously a consensus as to which is the best trading mechanism or which of the available trading mechanisms suits best stocks with specific characteristics is far from clear. Call auctions are usually employed at the beginning or the end of the trading process to provide more efficient opening/closing prices since they allow order flow consolidation however call auctions are randomly used for the whole trading process since they restrict information flow and trading frequency. Most stock exchanges that used single call auctions as their main trading system have now changed to continuous trading achieving tremendous gains in terms of liquidity and informational efficiency, (Amihud, Mendelson & Lauterbach, 1997).

All those examples of stock exchange markets changing their trading systems suggest that more empirical research is needed to identify if there is any increase in quality in terms of informational efficiency and spread sensitivity to volatility when changing from one trading mechanism to the other. The existing empirical literature has concentrated on i) comparing the liquidity of continuous auction and dealer markets (Pagano & Roell, 1990; Lee, 1993; Stoll, 1993; Affleck-Graves, Hedge & Miller, 1994; Christie & Huang, 1994; Huang & Stoll, 1996), ii) the value gained by changing from single call auctions to continuous trading (Amihud, Mendelson & Lauterbach, 1997), iii) the effects of computerization of the trading process (Naidu & Rozeff, 1994), iv) market microstructure and returns volatility (Amihud, Mendelson & Murgia, 1990; Amihud & Mendelson, 1991; Gerety & Mullherin, 1994; Ko & Chung, 1995), v) trading mechanisms and price behaviour emphasizing the introduction of call auctions within continuous trading mechanisms (Ko, Lee & Chung, 1995; Amihud & Mendelson, 1987,1989,1991) with reference to the Korean, Japanese and US stock market respectively, vi) comparing dealerships and continuous auction with respect to informational efficiency following quarterly earnings announcements made during trading and non trading hours on the NYSE and NASDAQ (Greene & Watts, 1996), vii) intraday patterns of spreads, trading volume, volatility and changes in asymmetric information as a result of changes in trading systems (Naik & Yadav, 2004; Cai et al, 2004; Lai, 2007). In this study we wish to examine the degree to which informational efficiency changes as a result of i) changes in trading regime/closing price formation algorithms used each time with reference to FTSE100 & FTSE250 and ii) spread sensitivity to volatility under different trading regimes with reference to the UK market. We believe that there is a very good reason to focus on informational efficiency and spread sensitivity to volatility under different trading regimes because these characteristics of stock trading are linked to the expected rate of return of a traded financial asset.

The London Stock Exchange (LSE) had always been a pure dealership (quote driven market) but in October 1997 the LSE introduced an order driven system for FTSE100 stocks. In an order driven market, market makers are not obliged to provide liquidity. Changes in FTSE250 were introduced in 3/11/2003. The trading system changed from pure dealership (SEAQ) to a hybrid system (SETSmm, mm stands for market makers), which combines the benefits of SETS with LSE market making.

One would expect several changes to occur once a market changes from quote driven to order driven. From the individual investor's point of view access to trading is much easier which may increase the frequency and the actual numbers of investors trading. Now orders enter the computer straight away and they are matched instantly provided of course that there are orders with similar characteristics pending. It is obvious that the bargaining power of individual investors is increased given their ability to place limit orders achieving better deals. By placing limit orders investors avoid the cost of immediacy. From the market maker's point of view handling costs are lower because of automated order execution and bid-ask quote manipulation to maintain optimal inventory is no longer necessary since they are no longer obliged to act as liquidity providers. Of course changes in market microstructure (from quote driven to order driven) can have disadvantages as well. The limit order book can make every single investor (including market makers) more vulnerable to asymmetric information and thus reduce the incentive to trade, which may lead to reductions in liquidity. Pagano & Roell (1992) state that 'an electronic auction market does not provide a means for communicating the trading motives or identity of traders to the market at large beyond displaying brokers' codes alongside limit orders'. Jain et al (2003) find that the level of informed trading is the same for both dealers and SETS. Naik & Yadav (2004) do not find any evidence of an increase in information asymmetry after the introduction of SETS while Lai (2007) showed that information asymmetry, inside and effective spreads increased after 38 FTSE mid 250 stocks moved from SEAQ to SETS (not SETSmm).

The degree of informational efficiency has attracted little attention and it is an issue worth examining as well. Every single participant in the market has access to the electronic limit order book and can decide more easily on the value of the asset based on the limit orders shown in the order book. However one might argue that given the easier access to trading, there will be more noise in the market distorting the real value of the asset and decreasing informational efficiency. Market makers are supposed to have a better 'feel' of the market at any point in time in comparison to individual investors who trade based on what they see on their screens. Wang (1999) with reference to the Sydney Futures Exchange has shown that floor traders can better assess the presence of adverse information i.e. they get a better feel of the market compared to screen traders who are isolated from each other. Experimental research (Thiessen, 2000) has shown that dealer markets can convey information of high quality once the bid-ask spread is eliminated. Greene & Watts (1996) with reference to the NASDAQ/NYSE markets show that NASDAQ is faster in impounding information into prices. Nevertheless no research has been undertaken with reference to the LSE and we do not know if the alleged enhanced ability of the market makers to get a better feel of the market will dominate over the electronic limit order book. In addition Viswanathan & Wang (2002) postulate that expected trading profits are higher in a limit order book setting while variance of profits is smaller in a dealership. If this is the case risk neutral investors will trade in a limit order setting while risk averse investors will trade in a dealership only. In the case of FTSE100 stocks which moved from a dealership to a limit order book setting are we expected to observe a reduction in trading (since risk averse investors will stop trading) and a decrease in informational efficiency? In the case of FTSE250 stocks which moved from a dealership to a hybrid market are we expected to observe an increase in trading leading to higher informational efficiency since now both risk averse and risk neutral investors would like to trade or the level of trading will remain the same as before?

Another issue, which has not been examined at all, is the spread sensitivity to volatility under different trading regimes for both FTSE100 and FTSE250. Cai et al (2004) look into the intraday pattern of volatility in the LSE and conclude that it is U shaped but they do not test for its effect on spreads before and after changes in the trading regime. Spread is supposedly less sensitive to volatility under an order driven regime for three main reasons: i) market makers do not have to manipulate bid-ask quotes to maintain optimal inventory therefore volatility is not more of a concern to them than it is to the rest of the investors, ii) inventory imbalances are diffused among a greater number of market participants since any investor can act conceivably as liquidity provider and iii) in case higher spreads occur because of increased volatility, this will invite more liquidity providers due to the opportunity of making increased profits. Of course it may also be the case that increased volatility will discourage investors to trade and since there are no liquidity providers of last resort as there are in a quote driven market, this will further increase the spread causing severe illiquidity.

In addition closing price formation algorithms could potentially affect price discovery/informational efficiency. The LSE has changed closing price formation algorithms three times ever since it has become an order driven market to accommodate investors' demands for more representative closing prices. Closing prices need to be representative of the trading activity each day since they are used in portfolio valuation and for trading after the exchange has closed. Following the introduction of SETS for FTSE100 (order-driven), closing prices were initially based on the last automated transaction (20/10/97-13/12/98), then closing price calculation was based on the ten minutes trading volume weighted average (14/12/98-26/05/00) and quite recently price formation is based on a closing call auction (30/05/00 onwards). We believe that the last two closing price formation algorithms provide more efficient closing prices and this should be apparent in the price discovery process because order flow is consolidated. As it has been stated above informational efficiency and spread sensitivity under different trading regimes and closing price algorithms are important issues relating to the expected return of a common stock worthy of further examination, therefore we seek to answer the following questions:

Q1) How does the degree of informational efficiency change in response to different trading regimes/closing price formation algorithms for FTSE100 and FTSE250?

Q2) How does spread sensitivity to volatility change in response to different trading regimes?

The results obtained in this study contribute to the trading mechanisms comparison literature with reference to the London Stock Exchange. First we show that the pace with which information is incorporated into prices is much faster in order driven markets when compared to quote driven markets (FTSE100). Secondly we show that spread is more sensitive to volatility in dealer markets because of their obligation to post affirmative quotes with respect to FTSE100 stocks. There appear to be no significant improvements in informational efficiency for FTSE250 when changing from quote driven to hybrid. In general terms the degree of informational efficiency remains the same. In addition spread sensitivity to volatility is the same since dealers are obliged to post affirmative quotes (committed principal orders) under both trading regimes. To summarize we have learnt that order-driven markets respond faster to new information (FTSE100) and that spread sensitivity is higher in dealerships because of their affirmative obligation to quote bid and ask prices.

Methodology

In order to answer how the degree of informational efficiency and spread sensitivity to volatility changes in response to different trading mechanisms and closing price formation algorithms we need to formulate six hypotheses:

H1) Closing auctions achieve a higher degree of informational efficiency when compared to trading volume weighted average pricing or closing prices based on the last automated transaction (with reference to FTSE100).

The main characteristic of closing auctions is order batching. In that way order flow consolidation and information consolidation is achieved and the possibility of obtaining a price incorporating as much information as possible increases. In addition the ability of block trading to distort prices is minimized due to the batching nature of single call auctions as well as the risk of trading under asymmetric information.

H2) Order driven markets achieve a higher degree of informational efficiency when compared to quote driven markets (with reference to FTSE100).

One could argue that that market makers have the ability to get a better 'feel' of the market and respond faster to general market conditions when compared to individual investors who trade mainly on information conveyed by limit orders posted in the electronic limit order book. Market makers have good information on market condition because they can observe buyers and sellers and their transactions. Market makers may have information on the clients of a broker and may be able to draw conclusions about any sort of information that he may possess from his buying and selling behaviour. They may also anticipate the behaviour of particular traders by estimating their inventory position. On the other hand, one could argue that market makers cannot always evaluate correctly the information they are presented with and the only information they may get is from the outstanding limit orders on their screens. In addition the ability to post limit could potentially increase participation from individual investors increasing information flow or noise. According to Pagano & Roell (1992) an electronic auction does not provide a means for communicating the trading motives or identity of traders to the market at large. Thus individual traders and market makers are not aware of the trading motives of their counterparts and can not assess their quantity and quality of information. Generally speaking the degree of informational efficiency between different trading regimes is an empirical issue.

H3) Hybrid markets achieve a similar degree of informational efficiency compared to dealerships (with reference to FTSE250).

The degree of informational efficiency achieved in those two markets is an empirical issue. On the one hand some might argue that the ability to post limit orders will improve information flow. On the other hand others might argue that the posting of limit orders will not necessarily improve order flow since limit orders may provide mixed signals, reducing informational efficiency. Lai (2007) shows that some FTSE250 stocks which moved from SEAQ to SETS (not SETSmm) experienced an increase in information asymmetry and a reduction in order submission which does not improve information efficiency. Obviously the degree of informational efficiency for quote driven and hybrid is an important empirical issue.

H4) Spread sensitivity to volatility is higher in dealer markets (with reference to FTSE100).

In a dealership, market makers are obliged to maintain an orderly market under any circumstances (volatile or non-volatile). Therefore the bid and ask quotes they post must incorporate some sort of compensation for volatility. In times of high volatility investors may wish to sell volatile stocks and buy less volatile stocks. Since markets makers have to accommodate liquidity demand under any circumstances, this will induce inventory imbalances accompanied by severe fluctuations in the value of their inventory. Obviously the spread will be more sensitive to volatility in dealerships in order to compensate for higher risk. Nevertheless in order driven markets, liquidity demand is diffused among a greater number of market participants since any investor can act as liquidity provider and in case higher spreads occur because of increased volatility, this will invite more liquidity providers due to the opportunity of making increased profits. Viswanathan & Wang (2002) postulate that profits are higher when trading in an order book. Therefore if the market is order driven, the spread will be less sensitive to volatility.

H5) Spread sensitivity to volatility is similar in dealer markets compared to hybrid markets (with reference to FTSE250).

In both trading regimes, market makers are present therefore we expect that spread sensitivity to volatility will be similar.

The methodology that follows was initially introduced by Amihud, Mendelson & Lauterbach (1997) to examine the degree of informational efficiency for different trading mechanisms. It was employed to test the efficiency of single call auctions and continuous trading in the Tel Aviv Stock exchange market. Variations of it were employed to test the efficiency of call auctions within the framework of continuous trading in the Tokyo Stock Exchange in two separate occasions. We use this methodology to examine the degree of informational efficiency between a dealership, an order driven market, a hybrid market and different closing price formation algorithms. This methodology is known as 'relative return dispersion' (RRD) and is based on the variance of returns across securities. In the first instance we need to regress individual stock returns on market index returns and obtain the residuals. Then we square the residuals obtained from the market model and average over the stocks included in our sample over different trading regimes and different closing price formation algorithms. Symbolically this is given by:

$$R_{it}=c+\beta MR_t+e_t \quad (1)$$

$$RRD_t=\frac{1}{N}\sum_{1}^{N}e_{it}^{2} \quad (2)$$

The dispersion of values at every single point in time due to firm specific information should be independent of the trading mechanism used each time, therefore any systematic differences observed between the different trading mechanisms and the different algorithms can be attributed solely to the trading mechanism. Lower relative return dispersion indicates smaller pricing errors relative to contemporaneous market index returns, which means that information is incorporated faster into prices. This may be due to faster adjustment to changes in the market index and smaller firm specific errors. Higher relative return dispersion indicates under reaction and may be due to lagged adjustment to market returns and high firm specific noise. The extent to which each of those factors (adjustment to market returns and firm specific noise) affects the degree of efficiency of each trading regime and closing price formation algorithms is examined by estimating a lagged market regression model for each stock in the sample:

$$R_{it}=c+\beta MR_t+L\beta MR_{t-1}+e_t \quad (3)$$

Where R_{it} is returns for each individual stock and MR_t and MR_{t-1} are contemporaneous and lagged index returns. Examination of the (in)significance of the coefficients obtained will allow us to determine if the degree of efficiency observed is due to lagged adjustment to the index. Controlling for lagged adjustment will also allow us to examine the variance of the residuals obtained from the lagged market model for each stock and see how fast firm specific information is incorporated in prices. Changes in the trading system should not have changed any fundamental information about the stocks traded; therefore any systematic differences in the variance of the residuals will reflect how fast firm specific information is incorporated in prices. If it turns out that the variance increases then firm specific information is not incorporated fast enough into prices and this can be attributed to the trading mechanism.

We modify the methodology described above (Amihud et al, 1997) by adding the Fama & French factors. Therefore equations (1) and (3) are re-written as:

$$R_{it}=c+\beta MR_{it}+SMB_t+HML_t+e_{it} \quad (4)$$

$$R_{it}=c+\beta MR_{it}+L\beta MR_{it-1}+SMB_t+HML_t+e_{it} \quad (5)$$

We also employ a second methodology (Theissen, 2000) to examine informational efficiency, which can only be used with high frequency data. In order to examine this we regress changes in transaction prices on changes in the real value of the asset (mid-quotes) and on past pricing errors. Symbolically this is expressed as:

$$(p_t-p_{t-1})=\alpha+\beta(v_t-v_{t-1})+\gamma(p_{t-1}-v_{t-1})+\varepsilon_t \quad (6)$$

where p_t is the transaction price as formed under the different trading regimes and v_t is the real value of the asset as captured by the mid-quote. In all empirical market microstructure studies, the mid-quote is generally accepted to be the real value of the asset. Kim & Ogden (1996) consider the mid-quote following a transaction as the real value of the asset and they use it to estimate the components of the bid-ask spread. In an efficient market the real value of the asset as captured by the mid quote should be reflected imminently in prices, therefore β should assume the value of one. If β assumes a value lower than one then it means that the market under reacts to incoming information while if it assumes a value higher than one then it means that it overreacts to incoming information. Restrictions on β are tested by Wald tests. γ provides estimates of the effects of past pricing errors on changes in prices and the extent to which they are corrected. In an efficient market γ should assume negative values meaning that past pricing errors are corrected, therefore the more negative the value is the faster past pricing errors are corrected. We strongly believe that the above methodology is the ultimate way to examine informational efficiency and provides first class evidence since it allows us to consider every single trade during the day.

In order to examine the effect of volatility on spread sensitivity under different regimes we need to introduce two separate measures of volatility. The first one will be used as an input to calculate a second liquidity indicator while the second one will be used as a regressor on the sensitivity model. The volatility measure which will be used as input is estimated as:

$$\text{VOLATILITY1}_{it} = \frac{H_{it} - L_{it}}{0.5(H_{it} + L_{it})} \quad (7)$$

Where H_{it} is the highest price recorded within the day and L_{it} is the lowest price recorded within the day. The difference between high price and low price divided by the average of those two prices can provide us with an indication of volatility under different regimes. However we believe that this is a crude measure of volatility to include as regressor in the sensitivity model because it fails to distinguish the effect of the trading mechanism from that of the general market environment (e.g news, events, liquidity and asymmetric information). For that reason we estimate a GARCH(1,1) model for each stock in our sample and incorporate in the variance equation changes in the real value of the asset as captured by the bid-ask midquote. The mean equation is given by:

$$R_t = c + e_t \quad (8)$$

Where R_t is returns and e_t is the error term. This equation is estimated separately for each stock in the sample. The variance equation is given by:

$$\sigma_t^2 = c + \delta\varepsilon_{t-1}^2 + \zeta\sigma_{t-1}^2 + \eta\left[\left(\frac{bid_t + ask_t}{2}\right) - \left(\frac{bid_{t-1} + ask_{t-1}}{2}\right)\right] \quad (9)$$

where σ_t^2 is the conditional variance, ε_{t-1}^2 is the lagged squared residual from the mean equation or news about volatility from the previous period, σ_{t-1}^2 is the last period's forecast variance and the term in squared brackets represents changes in the real value of the asset. We believe that by including changes in the real value of the asset we manage to separate the effect of the trading mechanism from the market environment. Any news, trading activity, liquidity or asymmetric information pertinent to each stock in the sample should be reflected in changes in the real value, captured by changes in the mid quote allowing full investigation of spread sensitivity to volatility. Wang (1999) comparing different trading systems in the Sydney Futures Exchange uses 'daily average transaction size' and 'number of trades' to separate the effect of the trading mechanism from that of the market environment. We believe that by incorporating changes in the real value of the stock we capture every change in the external environment. Spread sensitivity to volatility will be estimated by the following regression:

$$\text{spread}_{it}=c+\mu_{it}\sigma_{it}^2+e_{it} \quad (10)$$

where spread is the daily closing bid-ask spread for each stock in our sample and μ_{it} is the coefficient of the conditional variance for each individual stock obtained by running a GARCH (1,1). If μ_{it} turns out to be significant then it means that volatility affects the spread.

The above exercise is undertaken by employing high frequency data for FTSE100 and FTSE250 stocks. The only difference is that returns this time are based on transaction prices rather than daily closing prices.

Dataset and Descriptive Statistics

Daily price data for FTSE100 companies was obtained from DATASTREAM and transactions data from Securities industry Research Centre of Asia Pacific (SIRCA). The data set under consideration ranges from 18/10/1996 to 30/04/2003. The choice of the data set reflects a quote-driven trading regime and an order-driven trading regime, which is further sub-divided into three different closing price formation periods. This allows us to test the degree of informational efficiency under different trading regimes, which relates to the first and second research hypotheses and the extent to which spread is sensitive to volatility under those regimes which relates to the fourth research hypothesis. Each subset represents a different trading regime/closing price formation algorithm and incorporates the following time period: the first subset ranges from 18/10/1996 to 17/10/1997 and reflects a dealership where closing prices are based on the bid-ask midquote, the second subset ranges from 20/10/1997 to 13/12/1998 during which period the market is order driven and the closing prices were based on the last automated transaction (order book), the third subset ranges from 14/12/1998 to 26/05/00 during which period the closing prices were based on the last ten minutes of trading volume (VWAP: volume weighted average price) and finally the fourth subset ranges from 30/05/2000 to 30/04/2003 during which period the closing prices were formed by a closing auction. Unfortunately the transactions data sample does not extend over all those periods. We use trade data for two months following changes in the trading regime.

Daily price data for FTSE250 companies was obtained from DATASTREAM and transactions data from securities industry Research Centre Asia Pacific (SIRCA). The data set under consideration ranges from 01/01/2003 to 12/08/2004. The choice of the data set reflects a quote-driven trading regime (SEAQ) where liquidity is provided solely by market makers and a hybrid market (SETSmm) where individual traders can choose to trade between themselves if they wish to do so or trade with market makers who are obliged to provide liquidity through 'committed principal orders'. The change from one system to the other occurred in 03/11/03. This allows us to test the degree of informational efficiency under different trading regimes, which relates to the third research hypothesis and the extent to which spread is sensitive to volatility under those regimes, which relates to the fifth research hypothesis.

The daily data obtained includes the following variables: closing bid price, closing ask price, daily closing price, highest daily price, lowest daily price and closing trading volume. These variables were further processed to obtain other variables such as: bid-ask spread, bid-ask mid quote which is equal to (bid-price+ask-price)/2 and is used as a proxy for the real value of the asset, returns, returns volatility modeled as GARCH(1,1), 'volatiltity1' estimated as the difference between daily high and daily low prices divided by the average of those two prices and another liquidity measure 'L1' which is estimated as the ratio of volume turnover to volatility1. The intuition behind this liquidity measure is that if the £ amount of stocks traded is high while price movement is small then the market is very liquid. However if the £ amount of stocks traded is relatively constant but price fluctuation is high then this particular market is not liquid. The transactions data incorporates all trades, transaction prices, bid-ask quotes and volume.

Descriptive statistics for FTSE100 (Table no.1) with reference to the two liquidity measures employed here (bid-ask spread and L1) show that liquidity decreased once the market changed from quote driven (dealership) to order driven. In particular absolute spread appears to have increased from 2.66 to 4.18 following the change in the trading regime while it remains relatively stable for the rest of the periods examined. In order to decide on the (in) significance of changes in the mean values we undertake ANOVA tests. The increase in absolute spread following the change form quote driven to order driven is significant while changes in the spread for the rest of the periods are insignificant. The p values obtained for the estimated ANOVA statistic are much higher than 0.05. This result was somewhat expected since for the rest of the periods, the trading mechanism has remained the same; the only difference is in the closing price formation algorithm. The results obtained for absolute spread are further confirmed by L1, which captures liquidity in terms of £s of stocks traded controlling for price fluctuations. Higher (lower) values of L1 indicate that liquidity increases (decreases). When testing for mean (in) equality, the ANOVA tests show that the decrease in L1 is significant when the trading mechanism changes but changes in the mean values of L1 for the rest of the periods are insignificant at 0.05.

Descriptive statistics for FTSE250 (Table no.2) show that absolute spread decreased over the period examined which indicates an improvement in liquidity however ANOVA tests show that this improvement is not significant. The p value obtained is equal to 0.49. L1, which is an alternative measure of liquidity, shows that liquidity had actually decreased however ANOVA tests indicate that the decrease is insignificant. In other words the change from dealership (SEAQ) to a hybrid system (SETSmm) does not seem to have brought about any changes in liquidity.

Table no.1 and no.2: liquidity and volatility measures: FTSE100 and FTSE250 (p values in brackets)

TABLE 1 FTSE100				
FTSE100: LIQUIDITY MEASURES				
	ABSOLUTE SPREAD			
TRADING REGIME	SEAQ	SETS	SETS: VWAP	CLOSING AUCTION

MEAN	2.66	4.18	4.20	3.72
ANOVA		10.62 (0.00)	0.00 (0.96)	0.93 (0.33)
MEDIAN	2.49	3.40	3.15	2.93
S.D	1.73	3.73	3.28	3.10

TABLE 1 FTSE100			
FTSE100: LIQUIDITY MEASURES			
£ VALUE OF SHARES TRADED/VOLATILITY1			
SEAQ	SETS	SETS: VWAP	CLOSING AUCTION
538.5	226.3	148.6	387.7
	2.12 (0.03)	0.46 (0.64)	1.86 (0.06)
196.8	89.5	64.7	136.4
1217.3	470.8	190.5	916.7

TABLE 2 FTSE250			
FTSE250: LIQUIDITY MEASURES			
ABSOLUTE SPREAD		£ VALUE OF SHARES TRADED/VOLATILITY1	
SEAQ	SETSmm	SEAQ	SETSmm
6.84	6.14	178.3745	143.98
	0.68 (0.49)		0.66 (0.50)
4.68	4.03	51.56	40.36
9.47	7.47	478.96	397.69

Empirical Findings

The statistical analysis aims at i) investigating how fast information is incorporated into prices and the degree to which individual stocks under/over react to incoming information and ii) examine if and the extent to which bid-ask spread is sensitive to volatility under different trading regimes. Examination occurs under different trading regimes namely a dealership (SEAQ), a quote drive-market (SETS) and a combination of both (SETSmm) for the UK market.

Relative Return Dispersion: FTSE100 Stocks

The average value of squared residuals obtained by regressing individual FTSE100 stocks returns against the index, lagged market returns and the Fama & French factors appears to decrease over time

(Table no.3). The highest value is achieved when the market is quote-driven (dealership) implying that market makers fail to assess information as fast as they should. Once the market regime changes from quote driven (dealership) to order driven the mean squared value of residuals reduces by 0.01. ANOVA tests reject mean equality between the first two periods but fail to reject mean equality between the third and the fourth periods. This means that the introduction of a closing auction did not bring about the desired result of increasing the degree of informational efficiency achieved up to that moment implying that a closing auction is not much superior to that of VWAP (volume weighted average pricing). Actually a closing auction and VWAP appear to achieve the same degree of informational efficiency (H1 is rejected). The observed decrease in relative return dispersion between the first and the second period as captured by the mean values of the squared residuals can be attributed either to increased adjustments to changes in the relevant index or/and low firm specific noise. The extent to which each of these factors has contributed to the observed increase in RRD is examined by regressing stock returns to market returns, lagged market returns and FF factors.

The results presented in Table no.4 (PANEL A AND PANEL B) indicate that the degree of informational efficiency increases slightly following changes in the trading regime. When the market is quote driven (dealership) the coefficient for contemporaneous market returns assumes a highly significant positive value (0.73) implying that individual stocks respond to the index and the general market condition. Of course if individual stocks responded to a full extent the value obtained should be equal to 1. The R^2 adj obtained in this case is equal to 0.17. When we add lagged market returns we find that the coefficient of contemporaneous market returns remains the same and the coefficient of lagged market returns assumes a value of 0.11 which is significant indicating that individual stocks respond with a small lag to the index. R^2 adjusted increases slightly to 0.18. When the market regime changes from quote driven (dealership) to order-driven the coefficient of current index returns increases to 0.78 and R^2 ADJ becomes 0.20, indicating that the explanatory power of market returns has increased. When we add lagged index returns, the coefficient gets quite small. From 0.11 (quote driven market) reduces to 0.02 (order driven market). In this case R^2 ADJ increases indicating that FTSE100 stocks respond faster. This pattern remains valid for the rest of the periods examined. We would expect to see some changes for the second, third and fourth period given the change in the closing price formation algorithm however it appears that it is only changes in the trading regime itself (from quote driven to order driven) that can affect informational efficiency. PANEL B presents results for FTSE100 stocks incorporating the FF factors: SMB (equally weighted) and HML (equally weighted). The results are similar to the ones obtained from the simple regressions. The coefficient of contemporaneous index returns is equal to 0.69(0.00) for the first period (quote driven) and then increases to 0.72(0.00) for the second period (order driven). The coefficient of lagged index returns is equal to 0.10(0.00) for the first period (quote driven) and then reduces to 0.02(0.02) for the second period (order driven) indicating that the degree of informational efficiency increases in the second period (order driven). At this point it is worth mentioning that R^2 ADJ increases from 0.18 to 0.20. The FF factors are significant for both periods under consideration and their inclusion in the regressions do not appear to alter the results in any way. Results are qualitatively the same for the rest of the periods.

Size-based analysis: Results obtained for small and big companies indicate that it takes longer for smaller companies to adjust to incoming information. The coefficient of lagged market returns is slightly higher for smaller companies for most of the periods under consideration. In particular in the first period under examination (quote driven, Table no.4, PANEL A) the coefficient of lagged index returns for big companies is 0.11 and for small companies is 0.14. Of course it is not a sizeable difference but you need to keep in mind that the stocks under examination are FTSE100 stocks. Perhaps the results would be more pronounced if we employed stocks with major differences in market capitalization. When the trading regime changes the coefficient of lagged market returns for small companies reduces from 0.14 to 0.04 and for big companies from 0.11 to 0.01, which is evidence of improvement in informational efficiency. Results remain similar even when we add the FF factors.

Amihud, Mendelson & Lauterbach (1997) state that any increases/ decreases in RRD can very well be attributed to either lagged/increased adjustments to changes in the relevant index or/and high/low firm specific noise. The above exercise was undertaken to control for the effect of lagged adjustment and test the extent to which firm specific noise contributes to decreased RRD. The variance of the residuals (Table no.3) obtained from the lagged index regression and FF factors appear to decrease between the first two periods. ANOVA tests reject mean equality for the first two periods but fail to reject mean equality between VWAP and the closing auction, indicating that the closing auction is not superior to VWAP. Generally speaking while the change in market microstructure should not have changed any fundamental information about the stocks, it had a favourable effect on the precision with which new firm specific information is incorporated into prices.

Table no.3: FTSE100 squared residuals and residuals variance (p values in brackets)

	RELATIVE RETURN DISPERSION: SQUARED RESIDUALS WITH FF FACTORS FOR FTSE100			
TRADING REGIME	SEAQ DEALERS	SETS:LAST TRANSACTION	SETS: VWAP	CLOSING AUCTION
MEAN	0.0296	0.0121	0.0185	0.0189
ANOVA		12.7(0.00)	1.15(0.27)	1.11(0.26)
MEDIAN	0.0247	0.0108	0.0170	0.0177

RESIDUALS VARIANCE WITH FF FACTORS FOR FTSE100			
SEAQ DEALERS	SETS:LAST TRANSACTION	SETS:VWAP	CLOSING AUCTION
$0.5*10^{-3}$	$0.2*10^{-3}$	$0.2*10^{-3}$	$0.2*10^{-3}$
	8.75 (0.00)	0.39(0.69)	0.39(0.69)
$0.4*10^{-3}$	$0.1*10^{-3}$	$0.7*10^{-3}$	$0.4*10^{-3}$

Table no.4: FTSE100 informational efficiency over four different periods (p values in brackets)

PANEL A

QUOTE DRIVEN MARKET/DEALERSHIP:SEAQ								
	ALL		SMALL		MEDIUM		BIG	
C	0.00 (0.15)	0.00 (0.18)	0.00 (0.18)	0.00 (0.19)	0.00 (0.20)	0.00 (0.20)	0.00 (0.12)	0.00 (0.25)
MR_t	0.73 (0.00)	0.73 (0.00)	0.68 (0.00)	0.66 (0.00)	0.69 (0.00)	0.68 (0.00)	0.75 (0.00)	0.75 (0.00)
MR_{t-1}		0.11 (0.00)		0.14 (0.00)		0.14 (0.00)		0.11 (0.00)
R^2ADJ	0.17	0.18	0.18	0.19	0.17	0.18	0.20	0.21

ORDER DRIVEN MARKET:SETS-LAST AUTOMATED TRANSACTION								
	ALL		SMALL		MEDIUM		BIG	
C	0.00 (0.68)	0.00 (0.69)	0.00 (0.67)	0.00 (0.65)	0.00 (0.69)	0.00 (0.12)	0.00 (0.75)	0.00 (0.79)
MR_t	0.78 (0.00)	0.77 (0.00)	0.69 (0.00)	0.67 (0.00)	0.71 (0.00)	0.70 (0.00)	0.78 (0.00)	0.77 (0.00)
MR_{t-1}		0.02 (0.02)		0.04 (0.00)		0.05 (0.00)		0.01 (0.00)
R^2ADJ	0.20	0.20	0.20	0.21	0.21	0.21	0.19	0.20

VOLUME-WEIGHTED AVERAGE PRICE								
	ALL		SMALL		MEDIUM		BIG	
C	0.00 (0.00)	0.00 (0.00)	0.00 (0.10)	0.00 (0.12)	0.00 (0.13)	0.00 (0.15)	0.00 (0.22)	0.00 (0.28)
MRt	0.76 (0.02)	0.75 (0.00)	0.68 (0.00)	0.67 (0.00)	0.73 (0.00)	0.72 (0.00)	0.78 (0.00)	0.77 (0.00)
MRt-1		0.03 (0.00)		0.09 (0.00)		0.08 (0.00)		0.02 (0.00)
R2ADJ	0.19	0.19	0.19	0.20	0.18	0.19	0.19	0.19

CLOSING AUCTION								
	ALL		SMALL		MEDIUM		BIG	
C	-0.00 (0.45)	0.00 (0.00)	0.00 (0.45)	0.00 (0.80)	0.00 (0.20)	0.00 (0.34)	0.00 (0.42)	0.00 (0.40)
MR_t	0.70 (0.00)	0.69 (0.00)	0.65 (0.00)	0.66 (0.00)	0.68 (0.00)	0.66 (0.00)	0.73 (0.00)	0.72 (0.00)
MR_{t-1}		0.03 (0.00)		0.05 (0.00)		0.05 (0.00)		0.02 (0.00)
R^2ADJ	0.18	0.19	0.18	0.19	0.19	0.19	0.18	0.19

PANEL B

QUOTE DRIVEN MARKET/DEALERSHIP								
	ALL		SMALL		MEDIUM		BIG	
C	0.00 (0.08)	0.00 (0.06)	0.00 (0.08)	0.00 (0.09)	0.00 (0.09)	0.00 (0.10)	0.00 (0.10)	0.00 (0.11)
MR_t	0.69 (0.00)	0.69 (0.00)	0.62 (0.00)	0.63 (0.00)	0.64 (0.00)	0.68 (0.00)	0.73 (0.00)	0.74 (0.00)
SMB	-0.002 (0.00)	-0.00 (0.00)	0.01 (0.00)	0.01 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.001 (0.00)	-0.001 (0.00)
HML	-0.001 (0.01)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
MR_{t-1}	0.10 (0.00)		0.13 (0.00)		0.09 (0.00)		0.08 (0.00)	
R^2ADJ	0.18	0.17	0.17	0.16	0.17	0.17	0.20	0.19

ORDER DRIVEN MARKET:SETS-LAST AUTOMATED TRANSACTION								
	ALL		SMALL		MEDIUM		BIG	
C	0.00 (0.49)	0.00 (0.49)	0.00 (0.50)	0.00 (0.49)	0.00 (0.80)	0.00 (0.76)	0.00 (0.42)	0.00 (0.33)
MR_t	0.72 (0.00)	0.72 (0.00)	0.68 (0.00)	0.70 (0.00)	0.71 (0.00)	0.73 (0.00)	0.76 (0.00)	0.77 (0.00)
SMB	-0.002 (0.00)	-0.002 (0.00)	0.00 (0.00)	0.02 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.001 (0.00)	-0.001 (0.00)
HML	-0.001 (0.10)	-0.001 (0.10)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
MR_{t-1}	0.02 (0.02)		0.07 (0.00)		0.05 (0.00)		0.01 (0.00)	
R^2ADJ	0.20	0.20	0.20	0.19	0.20	0.18	0.21	0.19

VOLUME-WEIGHTED AVERAGE PRICE								
	ALL		SMALL		MEDIUM		BIG	
C	0.00 (0.06)	0.00 (0.06)	0.00 (0.09)	0.00 (0.10)	0.00 (0.12)	0.00 (0.15)	0.00 (0.10)	0.00 (0.15)
MR_t	0.72 (0.00)	0.72 (0.00)	0.65 (0.00)	0.67 (0.00)	0.70 (0.00)	0.73 (0.00)	0.72 (0.00)	0.75 (0.00)
SMB	-0.001 (0.05)	-0.001 (0.05)	0.01 (0.00)	0.01 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.001 (0.00)	-0.001 (0.00)
HML	-0.001 (0.05)	-0.01 (0.05)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
MR_{t-1}	0.02 (0.00)		0.07 (0.00)		0.06 (0.00)		0.02 (0.00)	
R^2ADJ	0.21	0.20	0.20	0.19	0.19	0.17	0.22	0.21

CLOSING AUCTION								
	ALL		SMALL		MEDIUM		BIG	
C	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
MR_t	0.67 (0.00)	0.68 (0.00)	0.60 (0.00)	0.63 (0.00)	0.67 (0.00)	0.70 (0.00)	0.73 (0.00)	0.74 (0.00)
SMB	-0.003 (0.00)	-0.003 (0.00)	0.01 (0.00)	0.01 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.001 (0.00)	-0.001 (0.00)
HML	-0.001 (0.00)	-0.001 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
MR_{t-1}	0.03 (0.00)		0.08 (0.00)		0.05 (0.00)		0.04 (0.00)	
R^2ADJ	0.19	0.18	0.17	0.16	0.19	0.18	0.19	0.18

Relative Return Dispersion: FTSE250 Stocks

The average value of squared residuals obtained by regressing individual FTSE250 stocks returns against the index and the FF factors appears to decrease over time (Table no.5) however ANOVA tests do not reject the null hypothesis of mean equality. In other words there appears to be no change in the degree of informational efficiency between a dealership and a hybrid market, which means that the third hypothesis is not rejected. The main characteristic of both trading systems (SEAQ and SETSmm) is the presence of market makers even though SETSmm allows trading through the electronic book. The ability to engage in individual trading (without employing the services of market makers) did not bring about an increase in informational efficiency.

In order to be consistent with the methodology described above, we need to present results for FTSE250 stocks response to current and lagged index returns following changes in the trading regime (Table no.6). By examining closely the results presented for stocks in FTSE250, one might argue that there is an improvement in informational efficiency given the increases in the coefficients observed for current market returns and reductions observed for lagged market returns. In particular the coefficient of current market returns increases from 0.60 to 0.74 while the coefficient for lagged market returns decreases from 0.11 to –0.05 following the introduction of the order book, however we can talk about 'real' increases in informational efficiency when the coefficient for lagged market returns is insignificant. In addition the change in the mean value of squared residuals discussed above is insignificant between the two regimes, which mean that the degree of informational efficiency has remained unchanged. At this point one should notice that the sum of current and lagged returns coefficients remains almost the same, 0.71 before the introduction of SETSmm against 0.69 after the introduction of SETSmm. The fundamental relation between returns on individual stocks and the market was unaffected by the change even though the coefficient of lagged market returns appears reduced. However this reduction is not significant to affect RRD. PANEL B presents results for FTSE250 stocks incorporating the FF factors. When the market is quote driven (SEAQ) the coefficient of current market returns is equal to 0.59 and the coefficient of lagged market returns is equal to 0.06. When the trading regime changes both coefficients increase. The increase in the coefficient of current market returns from 0.59 to 0.65 is offset by an increase in the coefficient of lagged market returns from 0.06 to 0.10 indicating that there is not any improvement in informational efficiency, thus the insignificant reduction in RRD (Table no.5). Residuals variance remains the same (Table no.5) which means that the degree to which firm specific information is incorporated into prices has remained unchanged.

Size-based analysis: the number of stocks in FTSE250 compared to FTSE100 allows us to vary the number of stocks included in the small and big groups so we run regressions for two different sub-samples in each category. Results obtained for the smaller groups show that the coefficient of current returns increases more when compared to the bigger groups. In particular, the coefficient of current returns for the 20 smallest companies in the sample (Table no.6, PANEL B) increases from 0.49 to 0.71 while the coefficient of current returns for the 20 biggest companies in the sample increases from 0.69 to 0.77. Unfortunately however this increase in the coefficient of current returns for small companies, which might imply an increase in informational efficiency, is offset by an increase in the coefficient of lagged index returns from 0.04 to 0.21 following the change in the trading regime. The coefficient of lagged index returns for big companies is insignificant under both trading regimes (Table no.6, PANEL B), implying that the change in the trading regime did not have much impact on the biggest companies even though it did increase the coefficient of current returns.

Table no.5: FTSE250 squared residuals and residuals variance (p values in brackets)

	RELATIVE RETURN DISPERSION: SQUARED RESIDUALS WITH FF FACTORS FOR FTSE250	
TRADING REGIME	SEAQ	HYBRID (SETSmm)
MEAN	$0.57*10^{-3}$	$0.44*10^{-3}$
ANOVA		1.02(0.30)
MEDIAN	$0.29*10^{-3}$	$0.24*10^{-3}$

RESIDUALS VARIANCE WITH FF FACTORS FOR FTSE250	
SEAQ	HYBRID (SETSmm)
0.02	0.01
	1.58(0.11)
0.017	0.015

Table no.6: FTSE250 informational efficiency over SEAQ and SETSmm (p values in brackets)

PANEL A: FTSE250 informational efficiency over SEAQ and SETSmm without FF factors

FTSE250: SEAQ/DEALERSHIP										
	ALL STOCKS		SMALL20		SMALL30		BIG20		BIG30	
C	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.70)	0.00 (0.78)	0.00 (0.26)	0.00 (0.35)
MR_t	0.61 (0.00)	0.60 (0.00)	0.46 (0.00)	0.44 (0.00)	0.52 (0.00)	0.50 (0.00)	0.72 (0.00)	0.72 (0.00)	0.70 (0.00)	0.70 (0.00)
MR_{t-1}		0.11 (0.00)		0.11 (0.00)		0.00 (0.00)		0.11 (0.00)		0.11 (0.00)
R^2ADJ	0.12	0.13	0.04	0.05	0.06	0.07	0.21	0.22	0.18	0.19

FTSE250:HYBRID/SETSmm										
	ALL STOCKS		SMALL20		SMALL30		BIG20		BIG30	
C	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.33)	-0.00 (0.29)	0.00 (0.85)	0.00 (0.82)
MR_t	0.75 (0.00)	0.74 (0.00)	0.84 (0.00)	0.84 (0.00)	0.75 (0.00)	0.75 (0.00)	0.77 (0.00)	0.76 (0.00)	0.77 (0.00)	0.76 (0.00)
MR_{t-1}		-0.05 (0.00)		0.04 (0.04)		0.00 (0.79)		-0.07 (0.00)		-0.07 (0.00)
R^2ADJ	0.10	0.11	0.03	0.04	0.05	0.05	0.17	0.17	0.14	0.15

PANEL B: FTSE250 informational efficiency over SEAQ and SETSmm with FF factors

FTSE250: SEAQ/DEALERSHIP FF FACTORS EQUALLY WEIGHTED										
	ALL STOCKS		SMALL20		SMALL30		BIG20		BIG30	
C	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.70)	0.00 (0.64)	0.00 (0.23)	0.00 (0.28)
MR_t	0.61 (0.00)	0.59 (0.00)	0.56 (0.00)	0.49 (0.00)	0.57 (0.00)	0.55 (0.00)	0.69 (0.00)	0.69 (0.00)	0.67 (0.00)	0.67 (0.00)
MR_{t-1}		0.06 (0.00)		0.04 (0.00)		0.04 (0.00)		-0.01 (0.29)		0.00 (0.76)
SMB	-0.00 (0.51)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)

HML	0.00 (0.09)	0.00 (0.13)	0.00 (0.95)	-0.00 (0.78)	0.00 (0.91)	-0.00 (0.80)	0.00 (0.28)	0.00 (0.31)	0.00 (0.60)	0.00 (0.68)
R^2ADJ	0.12	0.12	0.04	0.04	0.06	0.06	0.22	0.22	0.18	0.18

FTSE250:HYBRID/SETSmm FF FACTORS EQUALLY WEIGHTED										
	ALL STOCKS		SMALL20		SMALL30		BIG20		BIG30	
C	0.00 (0.03)	0.00 (0.04)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.67)	-0.00 (0.58)	0.00 (0.16)	0.00 (0.16)	0.00 (0.08)	0.00 (0.08)
MR_t	0.64 (0.00)	0.65 (0.00)	0.69 (0.00)	0.71 (0.00)	0.54 (0.00)	0.56 (0.00)	0.76 (0.00)	0.77 (0.00)	0.70 (0.00)	0.71 (0.00)
MR_{t-1}		0.10 (0.00)		0.21 (0.03)		0.21 (0.00)		0.07 (0.13)		0.10 (0.02)
SMB	0.00 (0.71)	0.00 (0.00)	-0.00 (0.15)	0.00 (0.75)	-0.00 (0.45)	0.00 (0.07)	0.00 (0.17)	0.00 (0.05)	0.00 (0.72)	0.00 (0.10)
HML	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.69)	-0.00 (0.74)	-0.00 (0.21)	0.00 (0.29)	-0.00 (0.04)	-0.00 (0.05)	-0.00 (0.23)	-0.00 (0.25)
R^2ADJ	0.08	0.08	0.03	0.04	0.03	0.04	0.16	0.17	0.12	0.12

Informational Efficiency: An Alternative Methodology

In this section we regress the transaction price of each trade on the real value of the asset as captured by the mid-quote and past pricing errors. Results presented in Table no.7 (PANEL A, all stocks) show that β increases from 0.06 to 0.68 following the change from quote driven to order driven indicating that individual stocks react much faster to incoming information. γ which provides an estimate of the past pricing error remains almost the same indicating that the degree to which pricing errors are corrected has not changed. In other words the informational efficiency of FTSE has improved following changes in the trading regime. The results presented for FTSE100 following this specific methodology are conducive to the results obtained by RRD. Unfortunately the Results obtained for FTSE250 are not as intriguing as those for FTS100 however they are conducive to the results obtained by using the RRD methodology. In particular β increases from 0.40 to 0.42 following the change from SEAQ to SETSmm while γ changes from -0.64 to –0.63. In other words there are no significant changes in the market. We undertake the same exercise concentrating on company size. Big companies appear to react faster than smaller companies' maybe because there is bigger coverage by analysts. The change in the trading regime does not seem to bring about any changes in the degree of informational efficiency as far FTSE250 stocks are concerned.

Table no.7: informational efficiency using high frequency data

PANEL A: FTSE100

	QUOTE DRIVEN MARKET/DEALERSHIP:SEAQ				ORDER DRIVEN MARKET:SETS-LAST AUTOMATED TRANSACTION			
	ALL	SMALL	MEDIUM	BIG	ALL	SMALL	MEDIUM	BIG
C	-0.35 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.09 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
β	0.06 (0.00)	0.05 (0.00)	0.08 (0.00)	0.13 (0.00)	0.68 (0.00)	0.72 (0.00)	0.83 (0.00)	0.91 (0.00)
γ	-0.89 (0.00)	-0.80 (0.00)	-0.87 (0.00)	-0.93 (0.00)	-0.87 (0.00)	-0.60 (0.00)	-0.89 (0.00)	-0.91 (0.00)

PANEL B: FTSE250

	FTSE250: SEAQ/DEALERSHIP				
	ALL STOCKS	SMALL 20	SMALL 30	BIG20	BIG30
C	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
β	0.40 (0.00)	0.28 (0.00)	0.31 (0.00)	0.62 (0.00)	0.53 (0.00)
γ	-0.64 (0.00)	-0.54 (0.00)	-0.56 (0.0)	-0.82 (0.0)	-0.77 (0.00)

FTSE250:HYBRID/SETSmm				
ALL STOCKS	SMALL20	SMALL30	BIG20	BIG30
0.00 (0.09)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
0.42 (0.00)	0.30 (0.00)	0.32 (0.00)	0.61 (0.00)	0.55 (0.00)
-0.63 (0.00)	-0.58 (0.00)	-0.58 (0.0)	-0.85 (0.0)	-0.79 (0.00)

Spread Sensitivity to Volatility: FTSE100 & FTSE250

The results presented in Table no.8 show that volatility appears to be significant when market makers set the spread. The coefficient obtained is positive and significant. However when trading occurs by submission of limit orders and the spread is regressed against volatility, it appears to be insignificant at 0.05 or 0.10. We believe that this is the case because inventory imbalances are distributed among all traders rather than a specific group of people namely the market makers, therefore volatility to market makers is not more of a concern than it is to every single investor. The results obtained indicate that the spread is more sensitive to volatility under a dealership than in an order driven market. When the effect of volatility on spread is tested for FTSE250 stocks (Table no.9) before and after the introduction of SETSmm, we find that volatility is significant for both periods and this is explained from the fact that under both trading regimes markets makers are present. Volatility does affect their inventories and as a consequence of that the spread must incorporate some sort of compensation for the extra risk that they face. The above findings provide support for the fourth and fifth hypothesis.

Table no.8: FTSE100 spread sensitivity to volatility over a quote driven market (dealership) and an order driven market

	QUOTE DRIVEN MARKET:SEAQ			ORDER DRIVEN MARKET		
	ALL STOCKS	SMALL	BIG	ALL STOCKS	SMALL	BIG
C	1.44 (0.00)	2.39 (0.00)	1.09 (0.00)	2.09 (0.00)	2.72 (0.00)	0.93 (0.00)
GARCH	0.43 (0.00)	0.74 (0.00)	0.16 (0.00)	0.71 (0.36)	0.80 (0.11)	0.49 (0.38)

Table no.9: FTSE250 spread sensitivity to volatility over a quote driven market (dealership) and a hybrid market

	QUOTE DRIVEN MARKET:SEAQ			HYBRID MARKET		
	ALL STOCKS	SMALL	BIG	ALL STOCKS	SMALL	BIG
C	3.23(0.00)	1.33 (0.00)	2.64 (0.00)	2.26 (0.00)	2.19 (0.00)	3.10 (0.00)
GARCH	0.39 (0.00)	0.49 (0.00)	0.23 (0.00)	0.42 (0.00)	0.40 (0.00)	0.32 (0.00)

Conclusion

The last years exchange markets around the world have embarked on a race to improve their services in an attempt to attract more and more investors. We investigate the degree of quality achieved by changing from an electronic quote driven market (dealership) to an order driven market and the efficiency of the various closing price formation algorithms employed each time in terms of price discovery/informational efficiency and spread sensitivity to volatility for FTSE100 and FTSE250 stocks. We find that there is no difference as far as informational efficiency is concerned between different closing price formation algorithms since the introduction of SETS (order driven market). However we find that order driven markets respond faster to information in comparison to dealerships. We also find that the spread is more sensitive to volatility in a dealership than in an order driven market. We are not aware of any other study examining informational efficiency or spread sensitivity to volatility in a similar setting therefore we can not compare the results obtained here. Stocks in FTSE250 were initially traded in a quote driven market (SEAQ) but then they changed to a hybrid system (SETSmm), which combines both market making and an order book. The degree of informational efficiency as well as spread sensitivity to volatility remains the same.

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