Journal of Economics and International Finance Vol. 1(1), pp. 001-013, June 2009
Available online at http://www.academicjournals.org/JEIF


*Full Length Research Paper*

# Price discovery, trading costs and insider trading: Evidence from a thin emerging market

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Accepted 14 May, 2009

**This research examines the impact of continuous trading system versus fixing system on liquidity, volatility, pricing error and order flows. Our results show that the continuous system show better price determination than the fixing system. This result is surprising. Indeed, temporal consolidation and the absence of effect of noisy orders should have led to a reverse conclusion. We suggest that in thin market, insiders and large investors take advantage of small investors at the opening. These later are usually liquidity traders and therefore are more concerned about the execution of their transactions rather the transaction prices and thus bear higher trading costs. In opposite most of participants in the continuous period are strategic traders. Insiders and large investors take advantage of multilateral trading mechanism during the opening (fixing) period at the cost of small investors. Our analysis of the trading costs shows that trading in thin market encompasses high trading costs because of low market liquidity, low trading volume, high volatility, significant pricing error and low market capitalisation that are specific to these markets.**

**Key words:** Market microstructure, market efficiency, volatility, emerging markets.

## INTRODUCTION

The complexity of the securities markets do not pertain primarily to the process of matching investors' orders; rather the difficulties involved when determining the prices at which trade should made are more complex. The efficiency of a stock market is directly related to the efficiency of its price discovery. In a good market, stocks trade at price close to their intrinsic values. The deviation of stock prices from this intrinsic value could be attributed informational market inefficiency or/and operational inefficiency. The first implies that security prices don't adjust rapidly to the arrival of new information and, therefore, the current prices of securities don't reflect all information about the security. The second is related to the market design and the process of physically matching and executing sell and buy orders. Indeed, the inefficiency of the trading system can result form inaccurate price discovery system, high level of trading costs (explicit and hidden costs), stock illiquidity; low market depth, exaggerated price impact, presence of friction in the market architecture…etc. Therefore any deviation of current stock prices from their intrinsic value could be source of abnormal return and as result could overcome the ultimate goal of stock market, which is the efficient allocation of resources to most productive businesses.

Inefficiency of trading system has been for a long confused with the informational efficiency. Indeed, the presence of significant serial correlation in stock returns has been often interpreted as informational inefficiency. Theoretical and empirical microstructure papers have shown that the market design has significant impact on stock price behavior. The inefficiency of the trading system could be responsible for the presence of autocorrelation of stock return Cohen, Hawawini, Maier, Schwartz and Whitcomb (1980) provides a synthesis on the impact of synchronism on stock price behavior. Schwartz (1991) suggests that "Transaction prices must be analyzed in light of the microstructure of the market.

Market impact effects, bid-ask spread, price rounding, and imperfect price discovery all result in three related phenomena: negative intertemporal returns correlation, inflated short period return variance, and serial cross-correlation in returns. Each is evidence of one reality : transaction prices generally differ from equilibrium values that would be achieved in a frictionless environment (an environment where trading is costless)." Roll (1984),

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**JEL classification:** G11, G15.

Campbell, Lo and MacKinley (1997) show that market architecture can induce under certain circumstances a negative serial correlation in stock returns. Theissen and Wolfgang (2000) state that: "Growing competition forces stock exchanges to react to customer needs. The design of the trading mechanism is the most important determinant of market performance."

This paper examines the impact of the trading mechanism on the behaviour of prices using data from the Casablanca Stock Exchange (CSE). Hence, we will study the liquidity, volatility, pricing error and the order flow during the preopening and the opening sessions. In what follows, we review the literature in section 2. We discussed the trading mechanisms employed by the CSE in section 3. Section 4 presents the data and the methodology and discusses the results, and section 5 concludes.

## Literature review

Several papers studied the impact of stock market organisation on market quality determinants such as liquidity, volatility, pricing error and order flow.

Derrabi, de Bodt, and Cobbaut (1999) examined the effect implementing a new electronic trading in Casablanca Stock Exchange on liquidity and stock price behaviour. The results showed that the automated fixing system had three effects: lower volatility of prices, market depth increase, and more efficient market prices.

Sioud and Hmaied (2000) studied the impact of automation on liquidity, volatility, efficiency and stock returns for the Tunisian Stock Market. They found that returns of all securities in their sample fell by almost 15% which show a stock price correction. The trading volume increased after automation. There was no significant effect on volatility which the authors explained by many factors that have contradictory effects on volatility:

-the increase in the volume of transactions which would increase volatility,
-the temporal consolidation of orders with fixing quotation which should reduce volatility,
-and the important fall of stock prices which would have resulted from heterogeneous expectations of market participants.

The automated system did not reduce pricing error nor did it improve the Tunisian Stock Market efficiency.

Amihud and Mendelson (1987) studied the microstructure effect of NYSE (New York stock exchange) on the price behaviour of securities. This market has two different trading procedures, the call market at the opening and the continuous trade until the closing. The opening period compared to the closing session was characterized by: higher volatility, greater return dispersion around the mean, more negative autocorrelation of returns, Liquidity was 8.4 times higher which is explained by the execution of the market order accumulated when the market was not operating. The NYSE microstructure thus revealed a significant impact on stock prices. The opening returns also exhibited higher residual noise and stronger dependence on past returns, reflecting stronger deviation from the market efficiency hypothesis based on the random walk.

Stoll and Whaley (1990) explain that higher volatility at the opening session is attributable to private information and to the price deviations induced by the market participants in the market notably "specialists". Suppliers of immediacy at the opening require premiums for their services which results in greater transaction costs compared to the closing period. George and Huang (1995) examined the volatility of prices at the opening and the closing over a large sample of TSE "Tokyo Stock Exchange" securities. Inversely, they found that volatility at the opening is grater than volatility at the closing only for the most actively traded stocks which implies a size effect. Cao et al. (2000) demonstrated that orders at the NASDAQ pre-opening session, even though not binding and although trading is nonexistent, contribute to an efficient price discovery system. They concluded that the contribution of the pre-opening period to informational efficiency has proven to be as important as during the trading day.

Biais et al. (1996) show that at the beginning of the preopening period of the Paris Bourse, prices reflect pure noise. This decreases as time increases at the same time the information content increases, which reflect a progression in the price discovery process. At the end of the pre-opening period indicative prices reflect an efficient learning of the real value of different stocks. Thus significant price discovery and learning occur during the pre-opening period and the mechanism of "Tâtonnement" contributes to the informational efficiency of the market.

Easley et al. (2004) demonstrate that stocks with greater private information require an information risk premium and on average the increase of 10% in the private information revealed an increase of 2.5% on annual expected returns. In the same sense, in this work, the authors showed that a zero investment portfolio based on private information which they called PIN factor earns returns that exceed other portfolios. This excess return could not be explained by the Fama – French factors nor could the CAPM provide a theoretical explanation of the effect of PIN as this model is based on traders without differential information which is the case for the PIN model.

Biais and Martinez (2004) studied the opening prices for German and French stocks set simultaneously in Frankfurt and Paris. They test the hypothesis that traders on the same market as a firm have better information about the value of the firm. Prices set on the domestic market are more efficient than those set on foreign markets. For the Paris Bourse prices were found to be com-

parable in the two markets. The German stocks on the other hand revealed significant price discrepancies between the home and the foreign market. The results showed also that financial markets are internationally fragmented due to informational asymmetries. A transparent price discovery system such as the one in the Paris bourse would "facilitate international financial markets integration".

Madhavan et al. (2001), define market transparency as the ability of participants to observe information about the trading process. In their paper, the authors emphasized that transparency really matters in the sense that it has an economic effect on trading costs and liquidity. The authors also demonstrated that market transparency does not improve market quality. Higher transparency according to them decreases liquidity because limit order traders are reluctant to offer free options to other participants.

Bloomfield and O'Hara (1996) conducted two experiments to investigate the effects of transparency on informational efficiency, bid–ask spreads and trader welfare in a dealer market. They concluded like the previous authors that market transparency greatly influences market performance. They found that transparency enhances efficiency but also gives market makers less incentive to compete for order flow which increases the bid-ask spreads and thus lowers liquidity of the market. They were even able to show that market makers might pay a premium to conceal their transactions and trade in a less transparent market.

Harris (1996) in a paper that examines stock orders and transactions taking place in the Paris Bourse and the Toronto Stock Exchange show that traders display more interest and make large orders when intraday volatility is small, when the minimum tick is large and when the order is not expected to stay long before the transaction. This implies that liquidity is very important even at the expense of transparency.

Very little work has been done to study the components of the bid-ask spread in stock exchanges and the results were different depending on numerous factors that may affect the trade. Reilly and Brown (2003) explain that there are three variables that correlate highly with the bid-ask spread. These are:

i.) The total market value of outstanding securities.
ii.) The number of securities owners.
iii.) The dollar value of trading.

The authors add that "the value of trading correlates highly with the market value of outstanding securities and the number of security holders. The relationship holds because, with more shares outstanding, there will be more stockholders to buy or sell at any time for a variety of purposes. Numerous buyers and sellers provide liquidity."

Calamia (1999) explains that in an efficient market the fundamental value of a stock fluctuates in a random way. The absence of trading costs means that price contains all relevant information. The compensation for investors for these costs is the bid-ask spread.

On the relationship between spread and volatility, Calamia (1999) shows that there is a positive correlation between volatility and spreads. Greater volatility is attributed to the wealth of information and to price uncertainty. Easley et al. (1996) and Calamia (1999) show that stocks that are not traded frequently should display higher spreads since they are information-based trades thus it is necessary to compensate investors for the high risk they are taking. They conclude that volatility and spreads are high in both cases: when a market is both thin and very active.

On the relation between volatility and volume, Calamia (1999) identifies a high correlation between the volume and the absolute value of price changes. This high positive link is explained by information arrivals. The bid-ask spread in a number of markets such as the NYSE, LSE, Nasdaq and others. In general, markets with an efficient price discovery produce these patterns. Dey and Radhakrishma (2001) discuss the role of institutional trading, argued that these institutions have superior information, better assimilation of information and greater access to markets. They also have lower transaction costs and thus trade frequently. The empirical evidence suggests a non-linear inverse relation between the bid-ask spread and institutional trading. The results showed that the net effect of increased institutional trading reduces the spread.

Institutional buys reduce the spread while the sells increase it. Market makers seem to be aware of this and adjust the effective spread accordingly.

Prucyk (2005) examines the relation between the bid-ask spread and the risk of the underlying stock. He explains that the bid-ask spread on the NYSE is determined not only by the absolute level of volatility of a stock, but also by changes in the level of its volatility.

This sensitivity implies a wider spreads both when volatilities are increasing and decreasing. This result is attributed to inventory risk that arises because of the change in volatility, the factor that pushes the specialist to be more active in his participation in the trade.

## Trading system in the Casablanca stock exchange

The Casablanca Bourse is a centralized, order driven market with market making provided by the brokerage firms. Orders in the electronic system are automatically sorted by price limit and in chronological order, in the "market order book".

Orders are then executed first by price, then in chronological order. Two orders of the same type (for instance, two buys) and with the same price limit are executed in the order in which they were entered into the system.

On the central market, there are three quotation

methods in which stocks are traded depending on their liquidity. The less liquid securities are traded on a call auction or fixing basis. The most liquid ones are traded on a continuous basis. And securities that fall in between are traded in the multifixing system.

Regarding market monitoring and supervision; there is a unit that monitors and exercises strict control over transactions. It has the power to stop trading in a security or limit fluctuations in prices where it sees this to be necessary for the market interest. The maximum movement authorized by the Casablanca Bourse during a single session is 6%.

## Data base

The objective of this work is to examine the impact of the organisation of the Casablanca Stock Exchange on the behaviour of prices. As stated in the introduction, this will be done, in a first section, through the analysis of liquidity, volatility, pricing error and order flow between the pre-opening period and the continuous system for each of the fixing and the continuous system. The second section will be an analysis of the bid-ask spread components. A third and last section will deal with the clusters of the Casablanca Stock Exchange.

The subsections that follow will examine data of the study, hypotheses of the study, the effect of the stock market organisation on liquidity, volatility, pricing error and order flow respectively, regression analysis results and cluster analysis results.

It is also important to mention that for the purpose of this study, we had recourse to two kinds of data.

On the one hand, we looked at daily prices and daily trading volume for a period of one year from March the 2nd, 2004 till March the 3rd, 2005. In addition, we looked at market total trading volume and the evolution of the MASI index that gathers all stocks traded in the market for the same period, to examine liquidity, volatility and pricing error (Note that for Maroc telecom, trading started on December 15, 2004).

On the other hand, data about all of these daily order values for a period of one month and a half from December the 1st, 2004 till January 14, 2005 was provided by “la Bourse de Casablanca”. These data were used to compute the bid-ask spread, and the order flow between the preopening and the continuous trading sessions.

## METHODOLOGY AND EMPIRICAL RESULTS

### Section 1: Impact of the organisation of the CSE on liquidity, volatility, pricing error and order flow

#### Hypotheses of the study

Research papers on stock market microstructure have examined four variables of operational market efficiency, which are liquidity, volatility, pricing error and order flow.

Amihud et al. (1997) as Lang and Lee (1999) found that liquidity was greater for the continuous auction compared to the call market for the Tel Aviv Stock Market and the Taiwan Stock Exchange. Amihud et al. (1997) and Amihud et al. (1987) demonstrated that volatility was greater at the Tel Aviv Stock Exchange and the NYSE in the call market as opposed to the Taiwan Stock Exchange where the continuous market exhibited more volatility.

In terms of efficiency, the call market was found to be more efficient than the continuous market at the Taiwan Stock Exchange and the Australian Stock Exchange, while the NYSE exhibits more efficiency in the continuous trade because of the intervention of market makers.

Taking into account these findings, the hypotheses are as follows:

H1: The continuous market exhibits more liquidity than the fixing system at the CSE
H2: Securities returns at the continuous system are more volatile than in the fixing market at CSE due to the temporal consolidation of the execution of orders in this latter system
H3: The continuous trading system is more efficient than the call market at the CSE
H4: The market microstructure has an impact on the behaviour of prices.

#### Liquidity in a continuous trading system versus fixing system

A market is liquid when assets can be bought and sold rapidly and at a price close to the equilibrium value. Theissen and Wolfgang (2000) as well as Reilly and Brown (2003) propose the “weighted average trading volume" to measure the market liquidity. More trading activity indicates a greater probability that traders may find a matching party for a desired transaction.

The trading volume is measured as weighted relative trading volume of each stock for a specific day (j) compared to the market trading volume:

$$VRM_j = 1/n \sum_{i=1}^{n} VR_{ij}$$

$VR_{ij}$ is the relative trading volume of stock i for specific day j compared to the market. It is computed as follows:

$$VR_{ij} = V_{ij} / VM_j$$

Where:
$V_{ij}$ is the volume of transaction of stock i at time j and
$VM_j$ is the total market volume at time j

For stocks traded in the fixing system, Derrabi (1999) suggests that liquidity should be important. Temporal consolidation of orders encourages participants to issue limit orders since they may benefit from the determination of a unique price at which all orders satisfying the price condition and temporal priority may be executed.

Derrabi (1999) shows the temporal consolidation of orders at the preopening period and the fixing of an opening price leads to high liquidity. To analyse the trading mechanism effect on liquidity, we compare the fixing and the continuous trading systems. Two series of 256 observations of the trading volume of each stock as a percentage of the market total trading volume are analyzed in the graphs (Figures 1 and 2).

The continuous trading system definitely displays higher liquidity over time: the trend is upward sloping for the period studied, and this reflects the participants’ behavior and preference for the continuous trading system. The extended trading period in the continuous system allows bilateral transactions. Investors have better

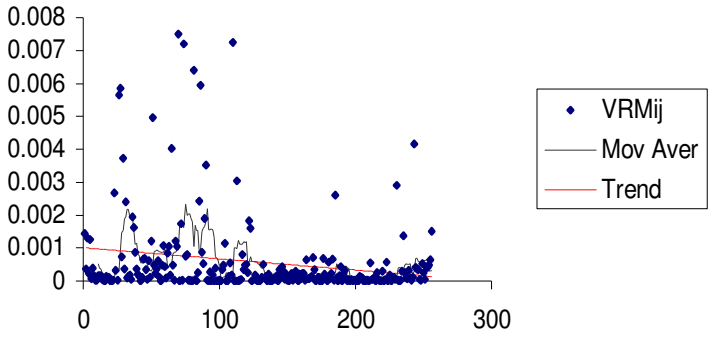


**Figure 1.** Daily relative volumes calculated over a period of one year for stocks traded at the fixing system. The curve shows 10 days moving average for the relative volume time series. The steady line represents the trend during the period.

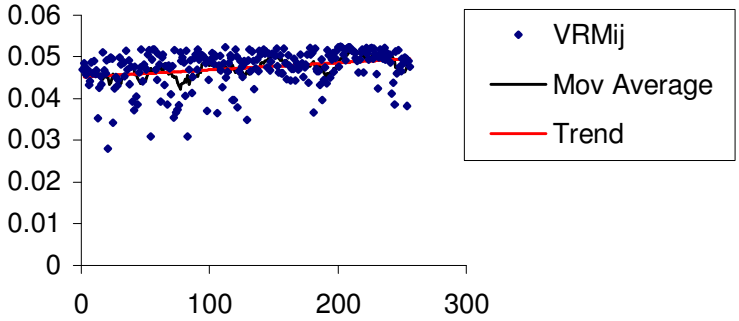


**Figure 2.** Daily relative volumes calculated over a period of one year for stocks traded at the continuous system. The curve shows 10 days moving average for the relative volume time series. The steady line represents the trend during the period.

control on the trading prices and enjoy high return as suggested by the shape of the two graphs.

Another explanation for the lower liquidity for securities traded in the fixing system is that these stocks are not traded daily as observed from the data collected from the CSE.

The results above conform with the findings of Amihud et al. (1997); Lang and Lee (1999) that liquidity is greater for the continuous auction compared to the call market at both the Tel Aviv and the Taiwan Stock Exchange.

These results suggest that in CSE, the continuous trading system offers more liquidity and higher immediacy for investors whereas the fixing system reduces the market liquidity and increase the waiting time for investors to trade. The results suggest that the market liquidity in CSE is significantly affected by the trading mechanism and thus affect the trading costs.

**Volatility in continuous trading system versus fixing system**

Volatility can be defined as price variations of financial assets. Either the variance or standard deviation of stock returns is often used to measure volatility according to Reilly and Brown (2003).
In this section, we will use the same 256 observations for the two systems to compare volatility. The formula for the variance is the following:

$$\sigma i^2 = \frac{\Sigma\ (R_i - \text{Mean Return of stock i})}{N}$$

$\sigma_i^{\ 2}$ is the variance
Ri is return of stock i
N is the total number of observations (Tables 1 and 2).

The results show that the mean variance of the stocks traded at the fixing system relative to the variance of the market is 9.14, while for the other group of stocks, it is 2.46, which shows that volatility of prices traded at the continuous trading system is less than the volatility of prices of those traded at the fixing system. The T statistics are significant at confidence level of 95%. Although our results are similar to those obtained by Amihud et al. (1987) in Tel Aviv Stock Exchange and Amihud et al. (1997) for NYSE, they are surprising. Indeed, we expect that the temporal consolidation of orders to buy and orders to sell should lead to reducing the market volatility. Stoll and Whaley (1990) suggest that the factors that market specialist's role to adjust the market liquidity may explain the high volatility in the NYSE at the opening (fixing). Amihud and Mandelson (1989) and Amihud et al. (1990) suggest that the over-night information and nondisclosure of market orders before the opening partially explain the high volatility in order driven market. In thin market such as CSE, this later factor is intensified by the overreaction of investors to new information and, sometimes, the

**Table 1.** Volatility of values traded at the fixing system. σi and σm represent, respectively, standard deviations of stock i and the market.

| | σi | σm | σi/σm |
|---|---|---|---|
| ACR | 0.0517 | 0.0055 | 9.4573 |
| BAL | 0.0973 | 0.0044 | 22.1394 |
| BNM | 0.0346 | 0.0061 | 5.6801 |
| CRN | 0.0558 | 0.0029 | 18.9287 |
| DIE | 0.1076 | 0.0072 | 14.9798 |
| FRT | 0.0230 | 0.0082 | 2.8225 |
| OUL | 0.0350 | 0.0070 | 4.9646 |
| PDT | 0.0676 | 0.0064 | 10.5456 |
| REB | 0.0325 | 0.0113 | 2.8759 |
| ZDJ | 0.0719 | 0.0074 | 9.6601 |
| LCT | 0.0423 | 0.0038 | 11.0201 |
| LGM | 0.0520 | 0.0077 | 6.7419 |
| SCE | 0.0325 | 0.0083 | 3.9178 |
| TSF | 0.0548 | 0.0081 | 6.7531 |
| SOF | 0.0464 | 0.0070 | 6.6435 |
| Mean | 0.0537 | 0.0068 | 9.1420 |
| Std Deviation | 0.0232 | 0.0020 | 5.5275 |
| T Stat | | | 3.3664 |

the irrationality of interpreting stock signal. Orders of institutional investors at the opening, although sometimes small, may induce high price volatility.

**Table 2.** Volatility of values traded at the continuous system. σi and σm represent, respectively, standard deviations of stock i and the market.

| | σi | σm | σi/σm |
|---|---|---|---|
| ATW | 0.0134 | 0.0071 | 1.8961 |
| BCE | 0.0104 | 0.0070 | 1.4739 |
| BCI | 0.0178 | 0.0069 | 2.5703 |
| CMA | 0.0186 | 0.0066 | 2.8003 |
| HOL | 0.0162 | 0.0071 | 2.2677 |
| IAM | 0.0103 | 0.0057 | 1.7917 |
| IBMC | 0.0236 | 0.0071 | 3.3426 |
| LES | 0.0224 | 0.0073 | 3.0793 |
| ONA | 0.0129 | 0.0071 | 1.8124 |
| SBM | 0.0193 | 0.0076 | 2.5579 |
| SID | 0.0167 | 0.0071 | 2.3448 |
| SNI | 0.0157 | 0.0067 | 2.3508 |
| WAA | 0.0146 | 0.0071 | 2.0442 |
| BCP | 0.0108 | 0.0079 | 1.3678 |
| CIH | 0.0401 | 0.0071 | 5.6424 |
| LAC | 0.0164 | 0.0074 | 2.2218 |
| MLE | 0.0319 | 0.0073 | 4.3509 |
| MNG | 0.0254 | 0.0067 | 3.7813 |
| SAM | 0.0173 | 0.0070 | 2.4759 |
| Mean | 0.0186 | 0.0070 | 2.6406 |
| Std deviation | 0.0075 | 0.0004 | 1.0480 |
| T-Stat | | | 12.9700 |

**Pricing error**

**Pricing error across stocks**

The reforms of the trading mechanism at Casablanca Stock Exchange was aiming at reducing price determination discrepancies, more transparency and better information efficiency, thus reducing errors related to determination of prices.

In this section, we investigate the pricing error in the continuous system versus the fixing system. We use the methodology suggested by Amihud and Mendelson (1989) that presents the Relative Return Dispersion based on the variance of returns across securities.

Less residual variance for one or the other of the trading mechanisms means a more efficient system and thus less noise for the determination of prices.

$RRD_t = 1/N \sum \varepsilon_{it}^2$

Where:
$\varepsilon_{it}$ is the market model residual of stock i on day t.

We estimate the market model:

$R_{i,t} = \alpha_i + \beta_i Rm_t + \varepsilon_{i,t}$

Where:
$R_{i,t}$ is the return of stock i at time t
$\alpha_i$ is an estimator of the parameter of each stock i that represents excess return specific to each security
$\beta_i$ is an estimator of the parameter that indicates the sensitivity of stock i to fluctuations of the market (Figures 3 and 4).

For the same study period, we observe that the relative return dispersion for stocks traded at the fixing system shows a slight increase and more fluctuation during the period than the securities traded at the continuous system, which show a trend relatively consistent and less dispersed in the RRD. This finding may be better supported by testing the pricing error on individual stocks.

**Pricing error on individual stocks**

This section will analyze the variance of residuals in each of the trading mechanisms for each security:
We will use the market model to determine the returns of securities as adopted by Derrabi et al. (1999).

$Ri,fs = \alpha_i + \beta_i Rm_t + \varepsilon_{i,fs}$ fs: fixing system
$Ri,_{CT} = \alpha_i + \beta_i Rm_t + \varepsilon_{i,CT}$ CT: continuous trade (Table 3 and 4).

The mean variance of residuals of stocks from the first group-traded at the fixing system is 0.0029 which is greater than the mean variance of residuals of securities traded at the continuous system, which is 0.000346. The findings are consistent with the results of the relative return dispersion above.

The continuous system show better price determination than the fixing system. This result is surprising. Indeed, temporal consolidation and the absence of effect of noisy orders should have led to a reverse conclusion. We suggest that in thin market, insiders and large investors take advantage of small investors at the opening. These later usually are liquidity traders and therefore are more concerned about the execution of their transactions and thus bear higher trading costs. In opposite most of participants in the conti-

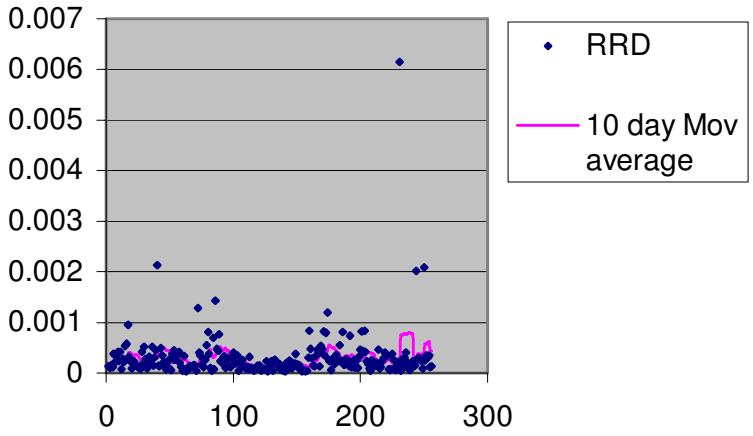


**Figure 3.** The relative return dispersion for stocks traded at the continuous system. The curve represents 10 days moving average of RRD series.

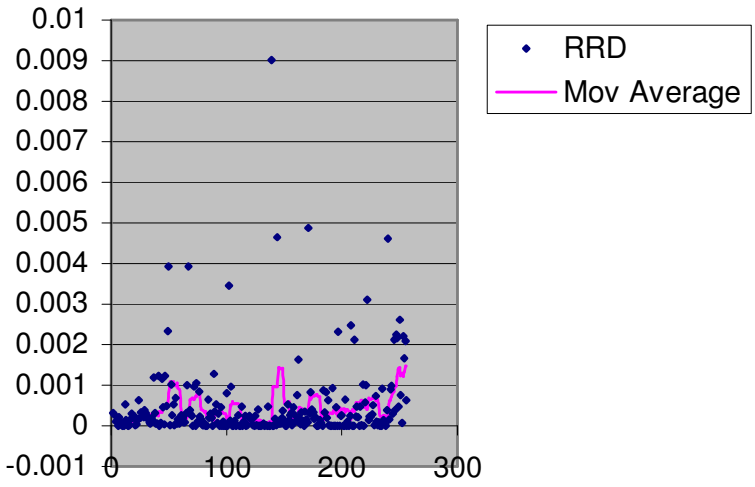


**Figure 4.** The relative return dispersion for stocks traded at the fixing system. The curve represents a 10 days moving average of RRD series.

continuous period are strategic traders. They put more efforts and more time in information search and consequently reduce pricing error. To confirm our suggestion, we propose a study of market orders flows in the two trading systems in Casablanca stock exchange

**Order flow**

The purpose of this section is to account for abnormal returns between the pre-opening periods and the opening session in each of the two trading mechanisms.

To this end, expected returns using the market model will be computed to compare them to opening and closing prices, respectively, and to determine which of the two sessions provides better efficiency for determination of prices.

Opening prices were computed by matching the orders received by the Casablanca Stock Exchange during the pre-opening session for a period of one month and a half starting the 1st of December, 2004, and ending the 15th of January, 2005 (Table 5 and 6).

The two tables above show clearly that the accumulation of orders during the pre-opening session permits a high level of efficiency and transparency as examined by many authors in the literature review.

The mean abnormal return for this period is very small and almost matches the expected returns in comparison with the closing period.

The opening session at the Casablanca Stock Exchange does not reward the performing companies as it should; it is rather underestimating their performance, which is shown in the table by the negative abnormal return which may harm investor interests. The tables below show the abnormal returns in the fixing system (Table 7 and 8).

The tables above show that both the preopening and the opening session for securities traded at the fixing system offer efficiency at the level of price determination which may be an expected result since these periods are based on the accumulation of orders which provide a sort of security for stock market investors.

In this section, we confirm our suggestion that in thin market, insiders and large investors take advantage of multilateral trading mechanism during the opening (fixing) period at the cost of small investors; whereas because transactions are bilateral in the

**Table 3.** Variances of residuals of securities traded at the fixing system.

| | Var ($\varepsilon_i$) |
|---|---|
| ACR | 0.0024 |
| BAL | 0.0050 |
| BNM | 0.0010 |
| CRN | 0.0030 |
| DIE | 0.0114 |
| FRT | 0.0005 |
| OUL | 0.0012 |
| PDT | 0.0045 |
| REB | 0.0009 |
| ZDJ | 0.0049 |
| LCT | 0.0000 |
| LGM | 0.0027 |
| SCE | 0.0010 |
| TSF | 0.0028 |
| SOF | 0.0021 |
| Mean | 0.0029 |

**Table 4.** Variances of residuals of stocks traded at the continuous system.

| | Var($\varepsilon_i$) |
|---|---|
| ATW | 0.00011 |
| BCE | 0.00010 |
| BCI | 0.00028 |
| CMA | 0.00025 |
| HOL | 0.00016 |
| IAM | 0.00008 |
| IBMC | 0.00054 |
| LES | 0.00043 |
| ONA | 0.00009 |
| SBM | 0.00029 |
| SID | 0.00018 |
| SNI | 0.00023 |
| WAA | 0.00017 |
| BCP | 0.00012 |
| CIH | 0.00161 |
| LAC | 0.00018 |
| MLE | 0.00099 |
| MNG | 0.00054 |
| SAM | 0.00024 |
| Mean | 0.00035 |

**Table 5.** Abnormal closing price returns for securities traded at the continuous system.

| | Abnormal returns |
|---|---|
| ATW | -0.0123 |
| BCE | -0.0876 |
| BCI | 0.0437 |
| CMA | 0.0445 |
| HOL | -0.0697 |
| IAM | 0.0296 |
| IBMC | -0.0447 |
| LES | -0.0873 |
| ONA | -0.0240 |
| SBM | 0.0097 |
| SID | -0.0725 |
| SNI | 0.0841 |
| WAA | -0.1134 |
| BCP | 0.0693 |
| CIH | 0.0673 |
| LAC | -0.1156 |
| MLE | -0.1796 |
| MNG | -0.1482 |
| SAM | -0.1135 |
| Mean AR | -0.0379 |

**Table 6.** Abnormal opening price returns for securities traded at the continuous system. Notice that stocks not shown on the table are those where no matching buy and sell orders were available to compute opening prices for this period of study.

| | Abnormal returns |
|---|---|
| BCI | 4.64E-17 |
| CIH | 1.3878E-17 |
| LAC | 2.6021E-17 |
| MLE | -6.8576E-18 |
| SAM | 3.6429E-17 |
| BCP | 0 |
| WAA | 0 |
| SNI | -3.3827E-17 |
| ONA | 0 |
| SID | 5.3343E-17 |
| LES | 8.9447E-18 |
| IBMC | 3.4694E-18 |
| HOL | 5.5728E-17 |
| IAM | 0 |
| BCE | 9.4868E-19 |
| Mean AR | 1.0796E-17 |

continuous system, it is difficult for investors to absorb abnormal returns prevailing during this period. The fierce competition at the opening
leads to better price determination and thus low abnormal return.

**Section 2: Trading costs and market efficiency**

The purpose of this section is to study the eventual impact of five variables volatility, pricing error, market capitalisation, volume and

**Table 7.** Abnormal opening price returns for securities traded at the fixing system.

| | Abnormal returns |
|---|---|
| BNM | 2.0383E-17 |
| BAL | 0 |
| ACR | 0 |
| REB | 0 |
| PDT | -1.6046E-17 |
| OUL | 0 |
| ZDJ | 0 |
| TSF | 0 |
| SOF | 4.8789E-19 |
| FRT | -1.4908E-19 |
| LGMC | -8.6736E-19 |
| SCE | 0 |
| Mean AR | 3.1736E-19 |

**Table 8.** Abnormal closing price returns for securities traded at the fixing system.

| | Abnormal returns |
|---|---|
| ACR | -4.8E-18 |
| BAL | 0 |
| BNM | 3.1E-17 |
| FRT | -6.5E-18 |
| OUL | 1.52E-17 |
| PDT | 2.78E-17 |
| REB | 0 |
| ZDJ | -5.4E-17 |
| LGM | -2.9E-17 |
| SCE | 0 |
| TSF | -2.1E-17 |
| SOF | 2.17E-17 |
| Mean AR | -1.6E-18 |

turnover on trading costs measured by the market spread. Previous results are different from market to market and from one trading mechanism to another. Theissen and Wolfgang (2000) and Reilly and Brown (2003) suggest the following formula to measure the bid-ask spread. A smaller spread, according to the authors, indicates greater liquidity.

The formula proposed is the following:

% spread = ((Ask-Bid)/(Ask+Bid)/2)

To test the way the volatility, pricing error, market capitalisation, volume and turnover affect the market spread, we suggest the following regression:

Bid-ask spread % = $b_0$ + $b_1$* Trading volume + $b_2$* Market capitalization + $b_3$ * Turnover+ $b_4$* Volatility+ $b_5$* pricing error+ μ

$$Y= b_0 + b_1* X_1+ b_2* X_2+ b_3 * X_3+ b_4* X_4+ b_5* X_5+\mu$$

will be used for each security traded in the continuous system to analyze the above mentioned aspects and the validity of the model.

Where:
the dependent variable is bid-ask spread (Y)
The independent variables are:
The trading volume ($X_1$)
The market capitalization($X_2$) = Number of shares * the price of the stock
Volatility($X_4$)
Pricing error($X_5$)
Turnover($X_3$): the percentage of outstanding shares traded during a period of time according to Lo and Wang (2001).
Turnover= $V_{jt}$ * $P_{jt}$ / $P_{jt}$* $N_{jt}$
$V_{jt}$: share volume of security j at time t
$N_{jt}$: total number of shares outstanding.
μ : residuals term

Hypotheses of the study (Attijariwafa Bank and Maroc Telecom intraday orders were not available, so they will not be taken into account):

H1: Transaction costs increase as volatility increases.
H2: Transaction costs increase as pricing error increases.
H3: Transaction costs decrease as the volume and the turnover increase.
H4: Transaction costs decrease as market capitalisation increases.

## RESULTS

### Ciment du maroc

For this security, regression has been run two times since better results were obtained when three outliers were removed from the observations.

The residual analysis seems to answer the assumptions of linearity. Frequency plots do not form a perfect bell-shaped curve but do not deviate very much from it, which assumes normality of distribution. The scatterplot of residuals does not show any systematic pattern. And, finally, the residual's fitting line shows a moderate fit, so the model is linear.

The regression results show that four variables out of five were retained. These variables are pricing error, volatility, market capitalisation and volume. The variable that was removed is turnover.

Correlation results show that there is a relationship between the spread and the rest of the variables. They suggest that there is an inverse relationship between the volume and the spread, and the turnover and the spread. Also, they demonstrate that there is a positive correlation between volatility and spread. This final result is as expected from the literature review: greater liquidity decreases the bid-ask spread.

The critical factor from the correlation results is the perfect correlation between the volume and the turnover. This suggests a problem of multicollinearity between the two variables, which explains why the statistical analysis removed the turnover.

F statistic is 23.993 > 2.78 (F critical) which shows that

**Table 9.** Relationship between the bid-ask spread and the independent variables.

| | Volume | Pricing error | Market capitalisation | Volatility | Turnover |
|---|---|---|---|---|---|
| CMA | - | + | - | + | |
| HOL | - | + | - | + | |
| SBM | - | - | - | - | |
| SNI | + | - | + | + | |
| SAM | - | + | - | + | |
| CIH | | - | + | + | - |
| LES | | + | - | + | - |
| ONA | | - | - | - | + |
| MLE | | + | - | - | - |

the regression equation significantly explains the variation in the bid-ask spread.

The coefficient of determination $R^2$ shows that 80% of the variation in the spread was explained by the model.

In terms of T statistics, pricing error, volatility measured by the standard deviation, and market capitalisation have T statistics respectively of 8.147, 3.889 and -2.444 > 2.064 which allows the rejection of the hypothesis that there is no relationship between the spread and these three variables.

The T statistic for the volume is not significant, so for the Ciment du Maroc, we may reject the relationship between this variable and the spread.

The coefficients suggest that there is a negative relation between the spread and the volume, and the bid-ask spread and market capitalisation. A positive relation, however, holds between volatility and pricing error with the spread. The findings for this company conform to expected results: the higher the liquidity, the lower the spread; the higher the pricing error, the larger the spread; and the higher the volatility, the higher the spread.

## BMCE

In the same way as Ciment du Maroc, residuals in the model prove the validity of the model's linearity. The results show that the model retained the same four variables out of five; these are pricing error, volatility, market capitalisation and volume.

There seems to be for BMCE a negative correlation between the pricing error and the spread, market capitalisation and the spread, and finally between volatility and the spread. Again, the same problem of multicollinearity between the volume and the turnover occurs in the case of BMCE.

F statistic is 2.102 which are lower than the F critical (2.76) and shows that the regression equation does not significantly explain the variation in the bid-ask spread.

## Holcim

Again the variable removed from the regression equation is turnover for the same collinearity problem. In this case, there is a negative correlation between the spread and three variables: volume, market capitalisation, and turnover. The coefficients confirm the negative relation with volume and market capitalisation. F statistic in this case is 3.387, which shows that the regression equation significantly explains the variation in the bid- ask spread.

The coefficient of determination $R^2$ shows that 33.4% of the variation in the spread was explained by the model.

In terms of T statistics, the volume and market capitalisation have T statistics respectively of -2.337 and -2.370 which rejects the hypothesis that there is no relationship between the spread and these two variables.

The T statistics for the pricing error and the volatility are not significant since they are lower than the T critical, so, for Holcim, we may reject the relationship between these two variables and the spread.

## Brasseries du maroc

Once again, the variable removed is turnover. Residuals analysis displays characteristics of normality and linearity as shown in.

Correlations among the independent variables and the dependent variable exist and are negative for all five variables with the spread. The coefficient signs confirm the correlation results. The overall result contradicts the findings in the literature review. F statistic in this case is 4.638, which shows that the regression equation significantly explains the variation in the bid-ask spread.

The coefficient of determination $R^2$ shows that the independent variables explain 40.7% of the variation in the spread.

T statistic is significant in this case for the volume only (-2.543). This compares with the findings of Deyand Radhakrishma (2001) that this is the case of heavy institutional trading which would decrease the spread (higher liquidity decreases the spread).

## Société nationale d'investissement

Correlations among all five independent variables of the

study and the bid-ask spread, are positive with a perfect positive correlation between the volume and the turnover, which have led, as in the previous cases, to a multi-collinearity problem. Once again the statistical analysis removed turnover.

F statistic in this case is 4.973 which show that the regretssion equation significantly explains the variation in the bid-ask spread.

The coefficient of determination $R^2$ shows that 42.4% of the variation in the spread was explained by the model.

In terms of T statistics, volatility seems to have the only significant T statistic (3.832). The other coefficients are not significant.

The coefficient for the pricing error shows that there is a negative relationship between the pricing error and the spread. The rest of the coefficients are positive.

Residual analysis displays characteristics of normality and linearity.

**Managem**

We have a low F statistic (.387) with a low $R^2$ (.056), which shows that the model cannot explain the variation in the spread.

**Samir**

For this company, the coefficients suggest a negative relationship between the spread and the volume, and the spread and market capitalisation. They suggest one significant and positive relation between the spread and the pricing error (T stat = 2.512), and a positive relationship with the volatility. The statistical analysis, as for abovementioned ones, has removed turnover because of the same problem of multicollinearity with the volume.

F statistic is significant (3.510). $R^2$ equals 35.1% which shows that 35% of the variation in the bid-ask spread is explained.

For the 10 next securities, the statistical analysis removed the volume instead of the turnover, always for the same reason the perfect positive correlation between the volume and the turnover which leads to a problem of multicollinearity.

**CIH**

Residual analysis displays characteristics of normality and linearity. Correlation results show that there is a relationship between the spread and the rest of the variables. It suggests that there is a negative relationship between each pairing of volume, pricing error, turnover, and market capitalisation with the spread. The only positive correlation is between the spread and volatility.

F statistic is 3.911 which show that the regression equation significantly explains the variation in the bid-ask spread.

The coefficient of determination $R^2$ shows that 36.7% of the variation in the spread was explained by the model.

In terms of T statistics, turnover has the only significant T statistic (-2.634) which shows the relation between the turnover and the spread. The three other variables are not significant in this case.

The coefficients suggest that there is a negative relation between the spread and both the pricing error and the turnover and a positive one for market capitalisation and volatility.

**IB. maroc**

Residual analysis shows that we may not assume linearity of the model. F statistic in this case is 2.895 which are higher than the F critical (2.74). This, of course, suggests that the model is significant in explaining the variation in the bid-ask spread.

$R^2$ equals 30.8% which means that only this proportion of the variation in the bid-ask spread is explained by the model.

Coefficients suggest a negative relationship between each of the pairings of the spread and market capitalisation, volatility and turnover. Their T statistics are, however, not significant.

Pricing error represents a T statistic of 3.139 and has a positive relationship with the spread in this case.

**Lesieur**

F statistic in this case equals 3.221, so the model explains significantly the variation in the bid-ask spread.

The coefficient of determination $R^2$ is 32.3%, meaning that the model explains this same proportion of the variation in the spread. The coefficients suggest a negative relation between market capitalisation and spread, and turnover and spread. They are positive for the rest of the variables. T statistics, however, are insignificant for all four variables.

**Sonasid**

F statistic for this company is not significant (1.818) and the $R^2$ suggests that only 22.1% of the variation in the spread is explained by the variables in the model.

The coefficients suggest that there is an inverse relationship between pricing error and spread, market capitalisation and spread, and volatility and spread.

**ONA**

Residual analysis displays characteristics of normality and linearity. F statistic is 2.914 which show that the model is significant in explaining the variation of the bid-ask spread. The coefficient of determination $R^2$ suggests that 30.2% of the variation in the spread is explained by

the model.

The relationship between market capitalisation and spread holds (T = -3.243).

Pricing error, market capitalisation and volatility's coefficients show a negative relation between each of them and spread.

The only positive relation is with turnover, but the T statistic is not significant.

**Wafa assurance**

It appears from the regression that there is a negative correlation between the bid-ask spread and all components of the regression model. The coefficients confirmed this result. These coefficients are, however, insignificant. F statistic (2.142) shows that the model does not explain the variation in the bid-ask spread. Residual analysis does not display characteristics of normality.

**Lafarge ciments**

The only positive correlation is with market capitalisation. All the other variables are negatively correlated with the spread.

F statistic (2.679) is slightly lower than F critical (2.74) and hence the model is insignificant.

**BMCI**

From the residual analysis, it appears that the condition of normality does not hold. The regression model for the BMCI shows positive correlations between the spread and both volume and turnover and negative ones with pricing error, volatility and market capitalisation.

F statistic (2.443) shows that the model is insignificant in explaining the variation of the bid-ask spread.

**Banque Centrale Populaire**

The regression analysis in shows that the spread is negatively correlated with market capitalisation, pricing error and volatility and is positively correlated with volume and turnover. It has a very low F statistic (.627) in comparison with F critical (2.74), hence the model is insignificant.

**Maroc Leasing**

Residual analysis for this company does seem to fit with the assumptions of linearity. However, the correlations show a positive relationship between the bid-ask spread and pricing error, and negative ones with the rest of the variables.

F statistic (18.530) shows that the model is significant. $R^2$ (74.8%) shows that this proportion of the variation in the spread is explained by the variables.

T statistic is significant for pricing error (8.056) and volatility (-3.038). Turnover, volatility and market capitalisation display negative coefficients, thus inverse relationships with the spread. Pricing error has a positive relationship with the spread.

**Summary of the results**

There are 8 securities out of 17 that showed that the model is insignificant in explaining the variation in the bid-ask spread. These securities are BMCE, Managem, Sonasid, Wafa Assurance, Lafarge Ciment, BMCI, BCP, and IBMC.

For the 9 other securities where the model is significant, results are summarized in the Table 9.

We may conclude from the table that there is a positive relationship that holds between volatility and bid-ask spread. For the few cases where there were negative relationships, T statistics were insignificant, except for "Maroc Leasing."

It is difficult for the pricing error to establish a relationship. However, for cases where T statistics were significant, the relationship was positive with the spread.

Regarding market capitalisation, the table suggests that there is a negative correlation with the spread and this holds because, in cases where T statistics were significant, the model displayed negative relations.

The volume and the turnover also have a negative relationship with the bid-ask spread. The T statistics were significant in some of the cases where the correlations were negative, which confirms the results of the table.

The four hypotheses have been confirmed for the Casablanca Stock Exchange. Our results suggest that trading in thin market encompasses high trading costs because of low market liquidity, low trading volume, high volatility, significant pricing error and low market capitalisation that are specific to these markets.

**Conclusion**

In this paper we examine the effect of trading mechanisms on stock price behavior using data from a thin market. We study the impact of continuous trading system versus fixing system on liquidity, volatility, pricing error and order flows. Our results reveal that consistently the market trading system affect these variables and thus the market efficiency. The continuous system show better price determination than the fixing system. This result is surprising. Indeed, temporal consolidation and the absence of effect of noisy orders should have led to a reverse conclusion. We suggest that in thin market, insiders and large investors take advantage of small investors at the opening. These later usually are liquidity traders and therefore are more concerned about the execution of their transactions rather the transaction prices and thus bear higher trading costs. In opposite most of participants in the continuous period are strategic traders.

They put more efforts and more time in information search and consequently reduce pricing error. Insiders and large investors take advantage of multilateral trading mechanism during the opening (fixing) period at the cost of small investors; whereas because transactions are bilateral in the continuous system, it is difficult for investtors to absorb abnormal returns prevailing during this period. The fierce competition at the opening leads to better price determination and thus low abnormal return.

Our analysis of orders flows in the two systems confirm this suggestion. Our analysis of the trading costs measured by the market bid-ask spread reveals that this later is negatively correlated with the trading volume and market capitalisation and positively correlated with the market volatility and pricing error. Therefore, trading in thin market encompasses high trading costs because of low market liquidity, low trading volume, high volatility, significant pricing error and low market capitalisation that are specific to these markets.

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