Trading mechanisms, return's volatility and efficiency in the Casablanca Stock Exchange

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This paper studies the impact of the stock market continuity on the returns volatility and on the market efficiency in the Casablanca Stock Exchange. For the most active stocks, the trading mechanism used is the continuous market which is preceded by a call market pre-opening session. Results obtained concerning return volatility and efficiency under the two trading mechanisms show that the continuous market returns are more volatile than the call market returns and 50 percent of stocks studied show independence between variations.

Keywords: Trading mechanism, microstructure, call market, continuous market, efficiency, volatility

1. Introduction

The microstructure of financial markets is the discipline that studies the modalities of the operational functioning of financial markets and the mechanisms that lead to the determination of prices at which stocks are exchanged. Thus, it discusses the impact of trading mechanisms on the pattern of financial markets. In this paper we will focus in the impacts of trading mechanisms, which differ from a market to other, on return's volatility and market efficiency.

Some stock markets apply the "call market" in which trading and orders executions occur at regular time intervals. All transactions are conducted at a single price determined to balance the sales and purchases orders. It is the only mechanism of exchange in some markets (The Arizona Stock Exchange, Bursa Malaysia, and Taiwan Stock Exchange). The call market can

be organized according to three modalities. The first one is the auction market (used in the New York Stock Exchange to determine opening prices) in which sellers and buyers are physically together in one place. For each stock, negotiators announce their offers or requests. This process continues until the discovery of the equilibrium price. The second modality allows participants to submit their bids and asks, without revealing their offers, until reaching the equilibrium price. In the third modality (used for the determination of the opening price in the Euronext Paris and in the Tokyo Stock Exchange), the buyers and sellers offers are revealed continuously to the market during their accumulation. The equilibrium price is calculated each time a new order arrives and until the auction time. The call mechanism is the main mechanism used by governments to sell their bonds and bills. It's also used to trade the least active securities in stock markets, among others, the Deutsche Börse, Euronext Paris, Bolsa Mexicana de Valores and Casablanca Stock Exchange (Hillion *et al.*, 1997).

Other stock markets apply the "continuous mechanism" in which trading and transactions are executed continuously. When this mechanism is used, an agent can send its order at any time. This order is executed whenever it finds a counterpart. Transactions in continuous mechanism are bilateral unlike the call markets where transactions are multilateral. In a continuous market, traders can observe bid and ask quotations, transaction prices, trading volume during the trading day. This enables them to assess the market conditions before placing their orders. Furthermore, the posting of quotes in a continuous market gives traders the option of placing market orders and ensuring execution of their trades (Chandrasekhar, 2009). The well known continuous stock markets are: Euronext Paris, Tokyo Stock Exchange, Toronto Stock Exchange, New York Stock Exchange, NASDAQ, and London Stock Exchange. Generally, the continuous market is reserved to the most active shares. Nowadays, most major markets are continuous with an auction pre-opening session. Other Stock markets

such as Hong Kong Stock Exchange, Singapour Exchange and Jakarta Stock Exchange use the continuous modality for the entire trading day.

Since 1980, researchers were interested to analyze the impact of trading mechanisms on volatility. Analyzing the price behavior of the components stocks of the Dow Jones Industrial Average, Amihud and Mendelson (1987) found that call market return variance (subject to the call method) was greater than continuous market return variance (subject to the continuous method). In their analysis of Borsa Valori Di Milano (Milan Stock Exchange), Amihud, Mendelson and Murgia (1990) compare return volatilities for stocks over the same period but under different trading mechanisms (under the call market and the continuous market) and at different time of the trading day. They conclude that the call market provides a more effective price discovery mechanism at the opening of the trading day than the continuous auction method.

The available studies that compare the advantages and inconvenients of the call market and the continuous market conclude that the price is more stable in the call mechanism than the continuous mechanism. This stability may be explained by the reduction of volatility in the call market in which, orders could not arrive randomly and continuously. In addition, as trading orders accumulate over a fixed time-interval, the impact of a single large order becomes less severe (Chang *et al.*, 1999, p. 141). In the other side, the immediacy of orders execution and high liquidity are the main advantages of the continuous market.

Chang, Hsu and Rhee (1990) obtained the standard deviation of 10-minutes return under two auction markets in Taiwan Stock Exchange. They found that significant differences in volatility exist between the two trading methods, the continuous market's volatility is half of the call market's volatility, the continuous market method is able to reduce volatility without

sacrificing liquidity and price discovery is more efficient in the call market than the continuous market.

Amihud and Mendelson (1987) and George and Hawing (1994) compared the volatility and efficiency of the call market and the continuous market in NYSE and Tokyo market using respectively the variance and the first autocorrelation of the call market returns and the continuous market returns. The results obtained show that the variance of the call market was higher than that of the continuous market, and the first-order autocorrelation of the call market returns were strongly negative than the continuous market returns.

Derrabi and Agnaou (2009) used data about the Casablanca Stock Exchange to study the impact of continuous trading system versus fixing system on liquidity, volatility, pricing error and order flows. They remark that the call market was characterized by low market liquidity, low trading volume, low market capitalization and high volatility. Their results show that the continuous system show better price determination than the fixing system.

In this paper, we will compare the price behavior under the two mechanisms (the continuous market and the call system market) of heavily traded stocks in the Casablanca Stock Exchange. This paper is structured as follow. Casablanca Stock Exchange and its trading mechanisms are presented in the 2nd section. In the 3rd section, we will present the methodology and data used in our study. Section 4 is dedicates to the presentation of results. The last section serves to conclude.

2. Presentation of Casablanca Stock Exchange

The Casablanca Stock Exchange (CSE) is considered as one of the most dynamic stock markets in Middle East and North Africa region (MENA) and is part of the MSCI Emerging

Markets indices. The acceptance of the Moroccan Stock Market to these indices was the result of a multitude of reforms and renovations that have affected the financial system.

The Casablanca Stock Exchange was established in 1929 and it was known as "Office de Compensation des Valeurs Mobilières" (The Office for Clearing of Transferable Securities). With the reforms of September 1993, the CSE was privatized and is ruled as an association of brokerage firms. The CSE trading hours are Monday to Friday from 10:00 a.m until 3:30 p.m and transactions take either place on the trading floor - called Marché Officiel - or the upstairs OTC market - called Cession Directe (Ghysels and Cherkaoui, 1999).

The CSE, also known as the Moroccan Stock Exchange, is managed by "la Bourse de Casablanca" whose purpose is to meet different actor's requirements and to make the Moroccan stock market the best in Africa. The monopoly of brokerage is held by 17 brokerage firms (CDVM, 2009) whose main objective is to manage security's portfolios, to animate the stock market, to execute transactions and to advise companies wanting to go Initial Public Offering. These brokerage firms are represented among public authorities through the Association of Professional Brokerage Firms (Dahir No. 1-93-211, Chapter II, Article 82).

The national central securities depository is MAROCLEAR and the policeman of Casablanca Stock Exchange is the Securities Board (Conseil Déontologique des Valeurs Mobilières - CDVM) whose main objective is to ensure the protection of public savings invested in securities and the dissemination of legal information and regulatory requirements. Considered as a department of the Ministry of Economy and Finance which is involved in the enactment of laws relating to the stock market, the CDVM also ensures transparency and security of the Moroccan Stock Market as well as compliance with laws and regulations governing the market (Official Bulletin, Kingdom Of Morocco, 5th June 2008).

Despite the low number of listed companies (75 companies listed in Casablanca Stock Exchange and 3200 in NASDAQ, 2764 in NYSE, 472 in the Johannesburg Stock Exchange, 378 in Cairo and Alexandria Stock Exchange and 233 in the Nigerian Stock Exchange) that reduces the number of assets on the market and cannot meet the high demand due to the diversity of market players, the Casablanca stock exchange is considered as one of the most important and the most dynamic stock markets in Africa. The operations on securities in Casablanca Stock Exchange are done on the NSC (Nouveau Système de cotation or New listing System) platform V900 used by several other Stock Markets such as Euronext, Dubai and Tunis. This system allows the automatic routing of trade orders and conclusion of transactions according to the market rules.

Transaction in the Casablanca Stock Exchange can take place according to two trading mechanisms: the call market and the continuous market. The choice of trading mechanism depends on the liquidity of the share. Thus, the most active shares are traded under the continuous market with a pre-opening auction session, and the least active are traded under the call market.

The first session in the Casablanca Stock Exchange begins at 10:00 a.m. In the call market, orders are batched together for simultaneous execution at a single price. The price is determined through an algorithm that maximizes the number of trades that can be executed, with a time priority rule or a prorate system to determine which orders are executed first. The number of auctions on the day depends on the liquidity of the stock. It can be done 3 times on the day (10:00 a.m, 1:00 pm and 3:00 p.m). The auction is done electronically (using the Trading System NSC). Orders are accumulated in an order book run by a computer that calculates the equilibrium price and the session close at 3:35 p.m.

In the continuous market (reserved to the most active stocks), orders are processed continuously and thus produce changing prices. The continuous market is preceded by an auction pre-opening session. After the beginning of the session at 11:00 a.m and until the pre-closure of the market, the confrontation of the orders is done continuously and electronically. If this confrontation is possible, we obtain continuously a new price for each stock and the transactions accomplishment at this price is possible.

The pre-closing session begins at 3:25 p.m. During this period, brokers transmit their orders to the electronic trading system. The theoretical value of the stock is continuously calculated each time a new order is entered, modified or canceled. The session is closed at 3:30 p.m. At this time, for each stock, the system confronts orders previously recorded which allow the determination of a closing price.

3. Methodology and data

As indicated above, the main objective of this paper is to study the impact of Casablanca Stock Market trading continuity on return volatility and on the market efficiency and to examine the behavior of stock prices under the two trading mechanisms described above, the continuous trading mechanism and the call market. Thus, we calculate return volatility under both the continuous market and the call market and we analyze the impact of different trading mechanism on return volatility. For the study of market efficiency, we apply Fama's test wich is designed to detect the 1^{st}-order autocorrelation in order to verify the presence or the absence of the weak form of efficiency on our market.

In this study, we use the daily continuous price, $P_{C,T}$, recorded at the end of the continuous trading session and the daily call price, $P_{F,T}$, recorded at the beginning of every session (under the call market). Consequently, the continuous market return and the call market return are respectively defined by:

$$R_{C,t} = \log(P_{C,t}) - \log(P_{C,t-1})$$

$$R_{F,t} = \log(P_{F,t}) - \log(P_{F,t-1})$$

Accordingly, for each day, we measure two returns for each stock, one under the continuous market and one under the call market.

Volatility is a measure for variation of price of a financial instrument over time. The variance standard deviation of stock returns is often used to measure volatility. The equation used is:

$$\sigma_{k,C} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(m_k - x_k)^2} \quad , \forall\, k = 1, \dots, n$$

The hypothesis of market efficiency was developed by Eugene Fama who defined the efficient market as a market where there are large numbers of rational, profit-maximizers actively competing, with each trying to predict future market values of individual securities, and where important current information is almost freely available to all participants (Fama, 1965). According to Fama, an efficient market is also "a market in which prices always fully reflect available information" (Fama, 1970). The implication of the market efficiency is that "there is no way to use the information available at t-1 as the basis of a correct assessment of the expected return on security *j* which is other than its equilibrium expected value" (Fama, 1976, page 145), and thus means that there will be no serial correlation.

The serial correlation is used to test the independence of the successive realizations and then, the weak form of efficiency. "The partial autocorrelation between two variables is the correlation that remains if the possible impact of all other random variables has been eliminated" (Kirchgässner, 2007). The partial autocorrelation coefficient is defined by: $x_t = \rho_{k1}x_{k-1} + \rho_{k2}x_{t-2} + \cdots + \rho_{kk}x_{t-k} + u_t$, where is the coefficient of the variable with lag i if the process has order k. "The partial autocorrelations measures the correlation between x_t and x_{t-k} which remains when the influences of x_{t-1}, $x_{t-2, \dots,}$ x_{t-k+1} on x_t and x_{t-k} have been eliminated" (Kirchgässner, 2007).

The first-order autocorrelation coefficient is the simple correlation of the first N-1 observations, x, t=1, 2, 3…,N-1 and the next N-1 observations x, t=2, 3, 4…,N-1. When the serial correlation is absent, this means that there is independence between successive variations, and then it is a weak form efficient market. A serial correlation different from zero means that there is no independence between successive variations and the market is therefore not efficient.

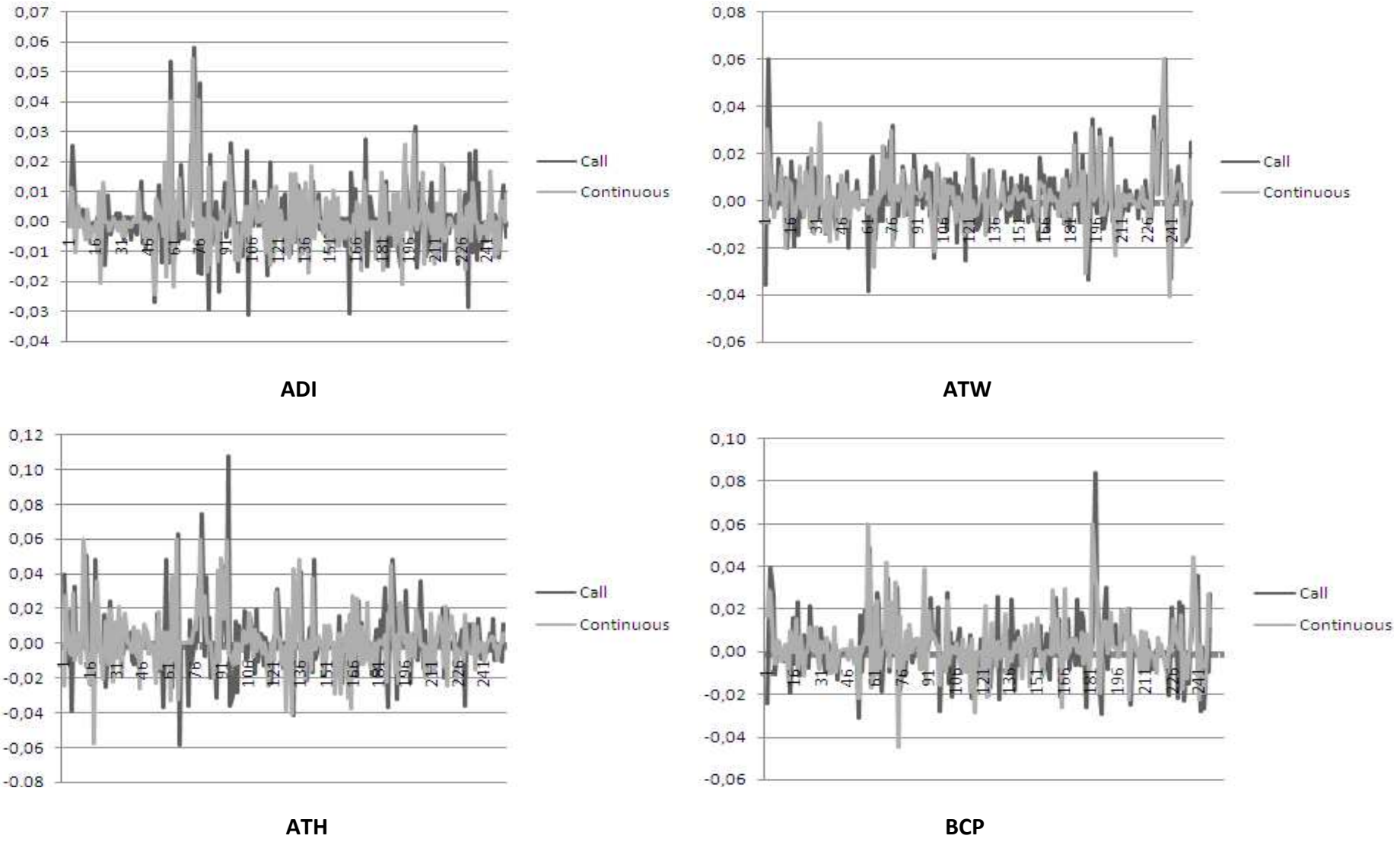
In his work, Kendall (Kendall and Hill, 1953) concluded that successive changes in a number of UK economic indexes (between 1928 and 1938), including shares and commodities, appeared to be random. The results of Fama for New York Stock Exchange price changes were similar to Kendall's results (the average of correlations coefficients was 0,026) (Broyles, 2003).

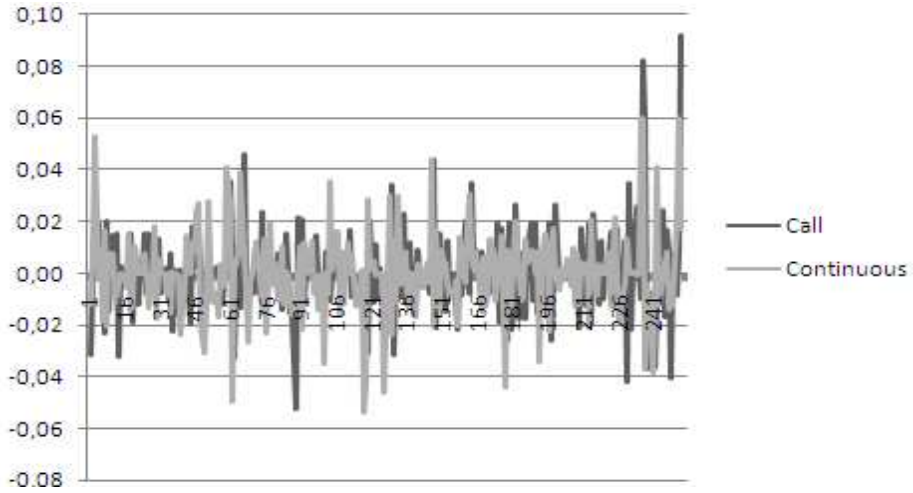
The data used in this study are drawn from the Casablanca Stock Exchange's database. For the period January 4, 2010 - December 31, 2010, we selected individual stocks that were continuously traded under both the continuous and the call market for at least 120 days. This time period was chosen to avoid missing data in the stock return files and to exclude the period of the stock market crash of 2007. These criteria resulted in a sample of 18 stocks that are among the most important Moroccan "blue chips" from the total of 75 listed stocks in Casablanca Stock Exchange. During this period, these stocks accounted for more than 87,27% of the total trading volume in Casablanca Stock Exchange. Table 1 presents explicitly the individual stocks used in this study, the weight and the activity of each stock. The main activities of these companies are banking, buildings and building materials, real estate, oil and gas, holdings and telecommunications. Figure 1 represents stock returns evolutions on the continuous market and the call market.

Table 1: Presentation of data: Stocks, weight and activity of each stock

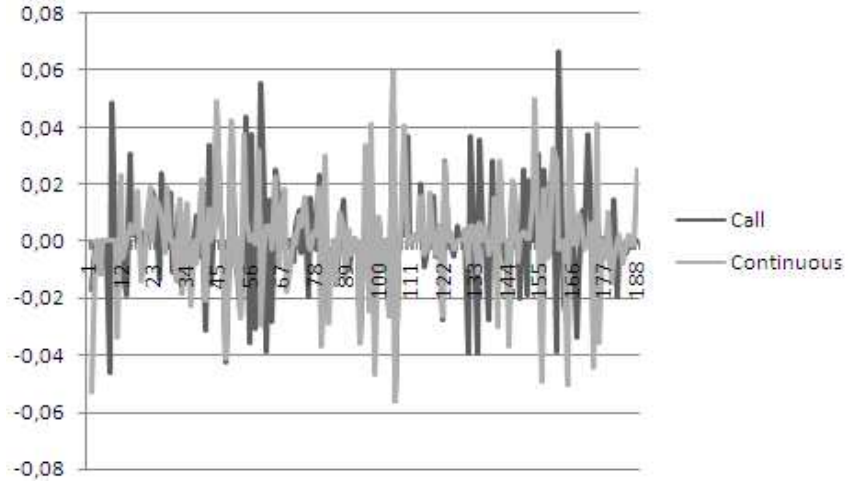
No.	Stock	Ticker	Weight	Activity
1	ALLIANCES	ADI	2,20%	Real estate
2	ATTIJARIWAFA BANK	ATW	15,75%	Banking
3	AUTO HALL	ATH	1,03%	Distributors
4	BCP	BCP	5,59%	Banking
5	BMCE BANK	BCE	7,09%	Banking
6	BMCI	BCI	2,19%	Banking
7	CDM	CDM	0.94%	Banking
8	CGI	CGI	3,94%	Real estate
9	CIH	CIH	1,51%	Banking
10	CIMENTS DU MAROC	CMA	2,78%	Buildings and building materials
11	DOUJA PROM ADDOHA	ADH	10,51%	Real estate
12	HOLCIM	HOL	3,58%	Buildings and building materials
13	ITISSALAT AL MAGHRIB	IAM	18,64%	Telecommunications
14	LAFARGE CIMENTS	LAC	5,94%	Buildings and building materials
15	MANAGEM	MNG	1,16%	Mining
16	SAMIR	SAM	1,68%	Oil and gas
17	SONASID	SID	1,69%	Buildings and building materials
18	WAFA ASSURANCE	WAA	1,99%	Insurance

Figure 1: Stock returns evolutions on the continuous market and the call market





BCE



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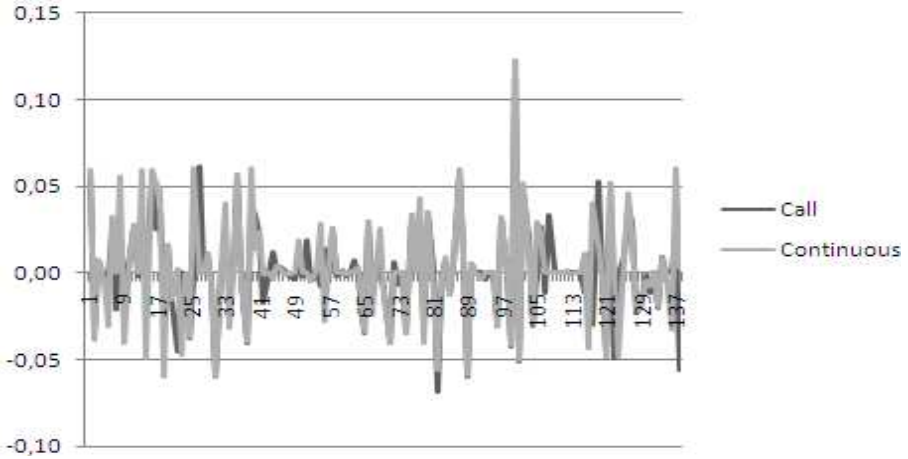
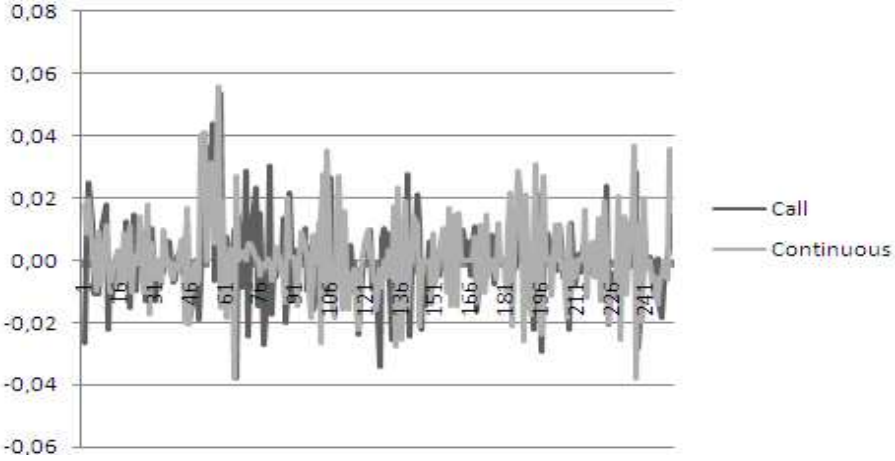


CDM



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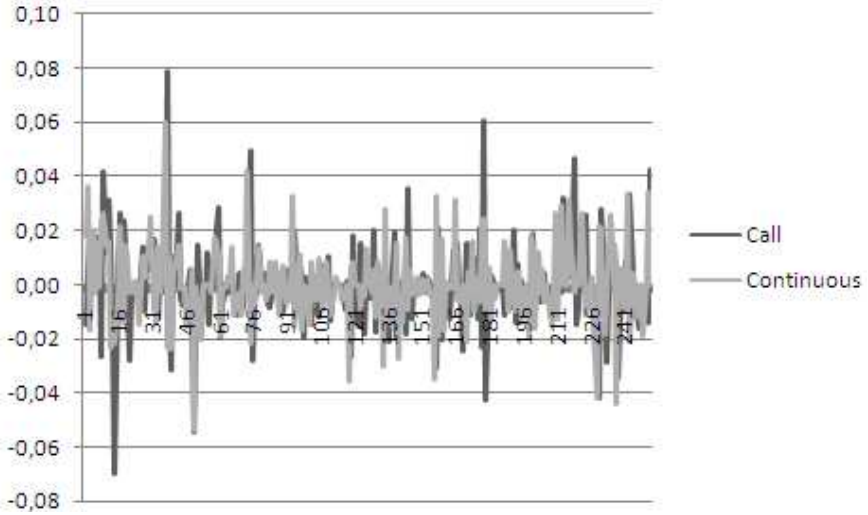
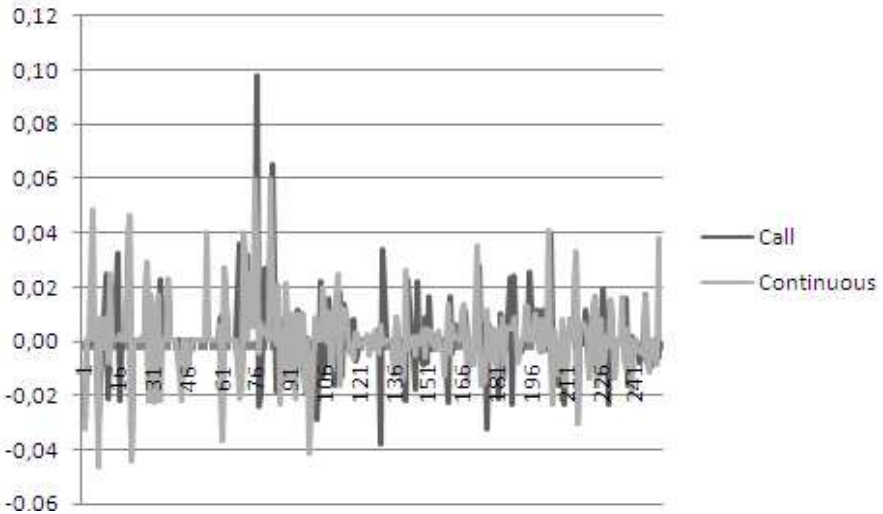
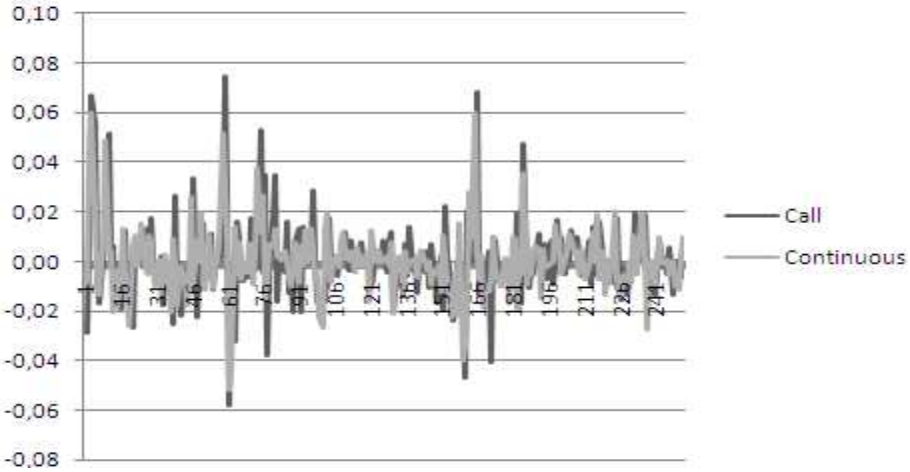


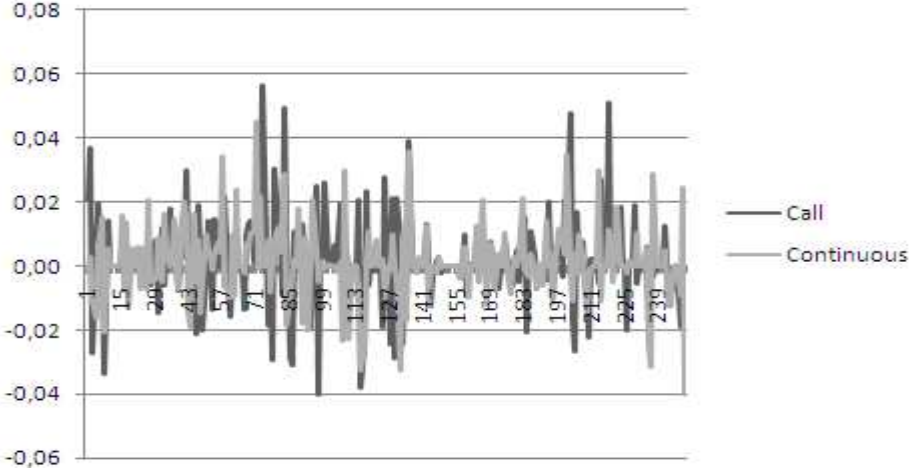
CIH



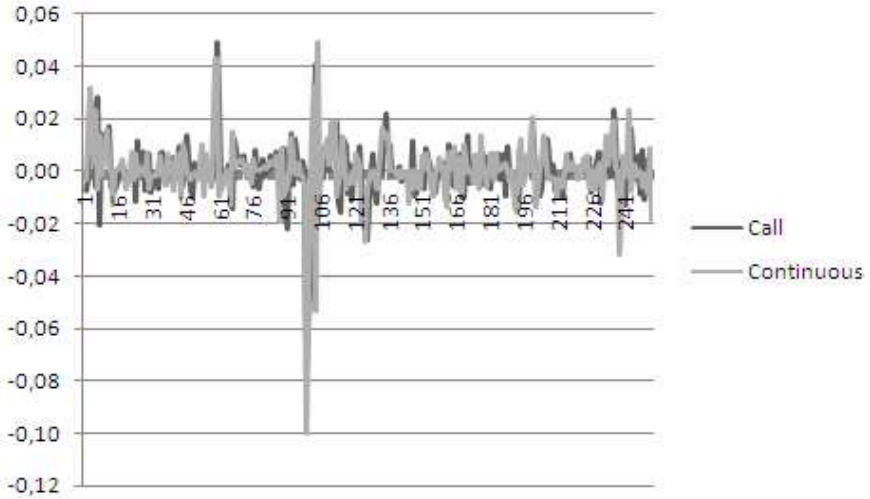
CMA



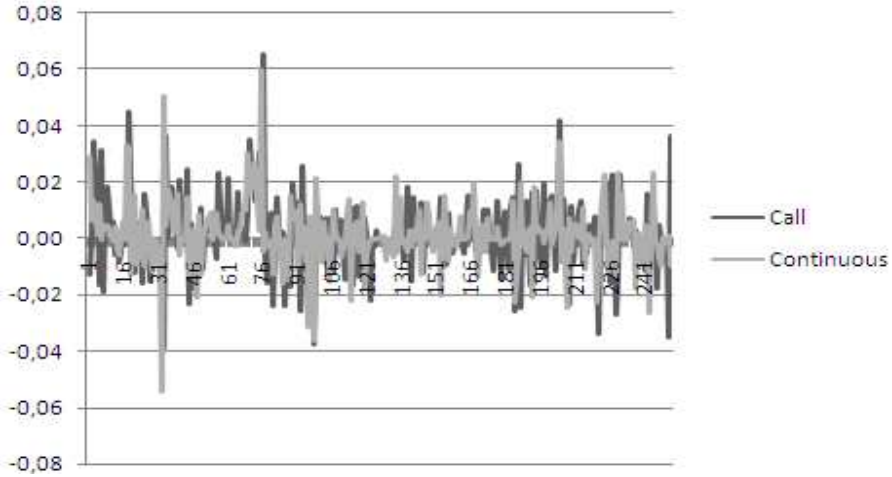
ADH



HOL



IAM



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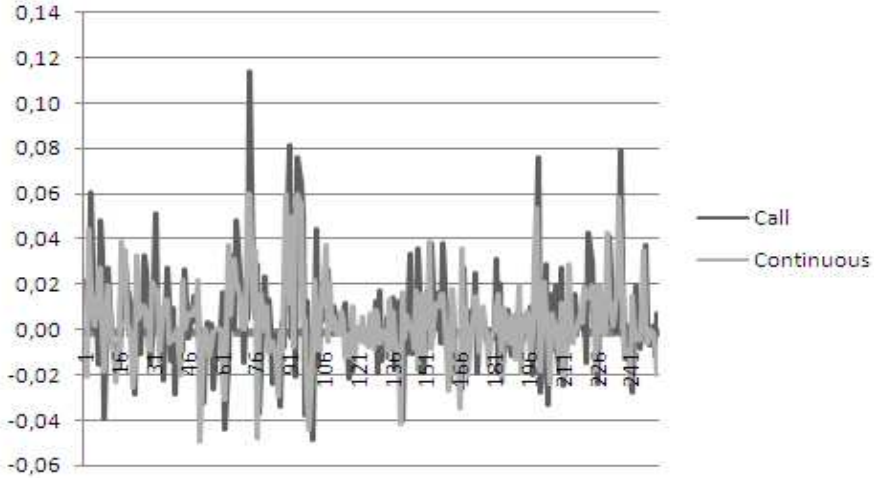

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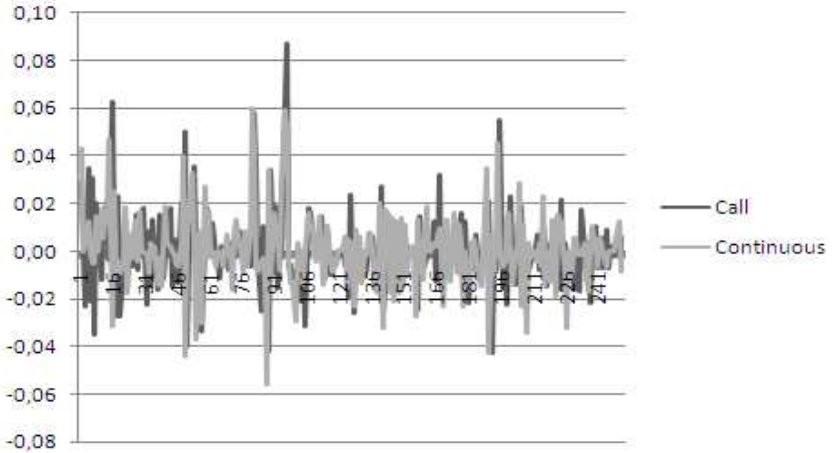
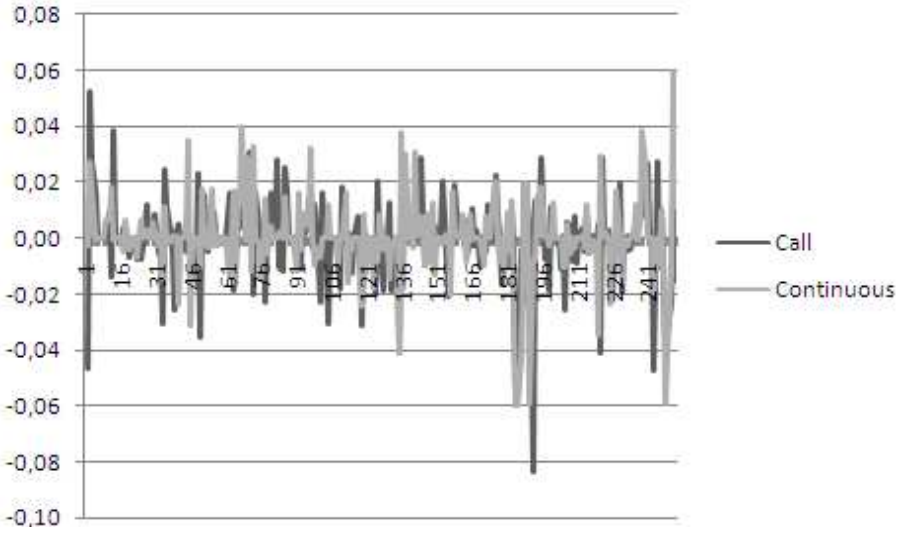


SAM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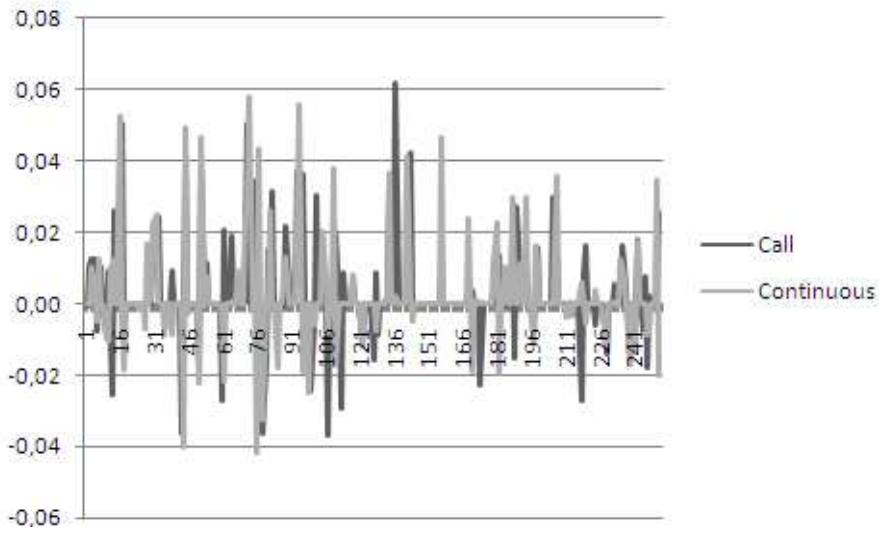
SID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WAA

4. Results and discussion

After measuring returns volatility of the Casablanca Stock Exchange stocks under the two trading mechanisms (the continuous market and the call market), we remark that for the eighteen values, the return's volatility for continuous mechanism is higher than return's volatility in call mechanism. The historical volatility in the continuous market varies between 0,71% and 2,11% versus a variation between 0,68% and 1,38% in the call market. We conclude that continuous market returns are more volatile than call market returns. This result confirms precedent findings obtained on New York Stock Exchange (Amihud and Mendelson, 1987), Japanese Stock Market (Amihud and Mendelson, 1991) and a number of Asian stock markets: Hong Kong, Korea, Malaysia, Singapore, Taiwan and Thailand (Rhee and Chang, 1992). Table 2 shows return volatilities in the continuous market and in the call market.

Table 2: Stocks, sample periods and return volatility calculated for the continuous market and the call market

No.	Ticker	Sample period	Trading days	Return volatiliy	
				Continuous market	Call market
1	ADI	04/01/2010 to 31/12/2010	253	0,75%	0,68%
2	ATW	04/01/2010 to 31/12/2010	251	0,96%	0,77%
3	ATH	04/01/2010 to 31/12/2010	248	1,36%	1,23%
4	BCP	04/01/2010 to 31/12/2010	248	0,98%	0,88%
5	BCE	04/01/2010 to 31/12/2010	253	1,21%	1,14%
6	BCI	04/01/2010 to 31/12/2010	189	1,42%	1,21%
7	CDM	06/01/2010 to 31/12/2010	138	2,11%	1,81%
8	CGI	04/01/2010 to 31/12/2010	253	0,99%	0,86%
9	CIH	04/01/2010 to 31/12/2010	251	1,12%	1,03%
10	CMA	04/01/2010 to 31/12/2010	231	1,42%	1,37%
11	ADH	04/01/2010 to 31/12/2010	253	1,02%	0,91%
12	HOL	06/01/2010 to 31/12/2010	228	1,05%	0,88%
13	IAM	04/01/2010 to 31/12/2010	253	0,71%	0,68%
14	LAC	04/01/2010 to 31/12/2010	246	1,03%	0,83%
15	MNG	04/01/2010 to 31/12/2010	251	1,63%	1,38%
16	SAM	04/01/2010 to 31/12/2010	252	1,13%	1,07%
17	SID	04/01/2010 to 31/12/2010	233	1,15%	1,01%
18	WAA	04/01/2010 to 31/12/2010	184	1,31%	1,20%

We then apply Fama's test of 1st-order autocorrelation to detect the presence or not of the weak form of efficiency. Applying this test using both continuous market and call market returns for 30 New York Stock Exchange stock returns, Amihud and Mendelson found that most autocorrelation coefficients were positive (24 out of 30) with an average of 0,0464 for closing return series. The autocorrelation coefficients of call market returns were negative (23 out of 30) averaging -0, 0635. For Shang Hai Stock Exchange stock returns (Lai et al., 1996), the results were different: the 1st-order autocorrelation of both call market and continuous market were both negative not only for the most actively traded stocks but also for that of the least actively traded. This result was explained by considering the SHSE as an emerging stock

market where the investors were much more speculative than those who invest in the developed financial markets.

Table 3: First-order Autocorrelation Coefficients for the continuous market and the call market returns

No.	Ticker	ρ(1) for the continuous market returns	ρ(1) for the call market returns
1	ADI	0,070*	0,012*
2	ATW	0,195	-0,090*
3	ATH	0,130	0,063*
4	BCP	0,089*	-0,080*
5	BCE	0,250	-0,120
6	BCI	0,086*	-0,130
7	CDM	0,196	-0,150
8	CGI	0,097*	0,063*
9	CIH	0,192	0,145
10	CMA	0,019*	-0,123
11	ADH	0,042*	-0,152
12	HOL	-0,049*	-0,167
13	IAM	0,223	-0,007*
14	LAC	0,292	0,093*
15	MNG	0,118	-0,045*
16	SAM	0,149	-0,023*
17	SID	-0,002*	-0,148
18	WAA	0,007*	-0,215

**** Autocorrelation coefficient significantly equal to zero at 5%***

After the application of the 1st-order autocorrelation to the Moroccan most active shares using both the continuous market returns and call market returns we found that, concerning the continuous market stock returns, almost all the autocorrelation coefficients (16 out of 18) are positive, with an average of 0,19 and that 9 stocks from 18 have an autocorrelation coefficients significantly equal to zero at 5%. Concerning the call market, 13 stock returns (out of 18) are characterized by a negative autocorrelation coefficient, in opposite to the continuous market, with an average of -0,11 and 13 stocks from 18 have an autocorrelation coefficients significantly equal to zero at 5%.

The variation of more than 50 percent of stock returns under the two trading mechanisms (9 on the continuous market and 13 on the call market) is then not random and there is dependence between these variations. The second part of stock returns is characterized by an independence of variations, and, variations are then random. Our hypothesis is that these results can be explained by the behavior of the investors in Casablanca Stock Exchange. The immaturity of the Moroccan stock exchange may explain this divergence of results and the random behavior of some investors, in the opposite of other investors with a deterministic behavior.

5. Conclusion

This article studies the impact of trading mechanisms on return's volatility and on the market efficiency in the Casablanca Stock Exchange. Normally, for the most active shares, trading in this market is done in the continuous market, preceded by an auction pre-opening session. After this period, trading proceeds continuously until the closing.

Results obtained after measuring the return volatilities for a stock over the same time but under different trading mechanisms show that return volatilities under the continuous mechanism are higher than return volatilities under the call mechanism. The continuous market returns are more volatile than the call market returns in the Casablanca Stock Exchange. The difference between return volatilities is attributed directly to the effects of the trading mechanisms. This result confirms precedent results obtained on American, Asian and European markets.

After the application of the weak efficiency test – the Fama's test of first-order autocorrelation – to our data, using both the continuous market and the call market returns, we observed that 50 percent of stock returns studied show independence between variations. We cannot conclude which trading mechanism provides more efficiency in the Casablanca Stock Exchange.

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