Impact of the transition to continous trading on emerging financial market's liquidity : Case study of the West Africa Regional Exchange Market (BRVM)

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IMPACT OF THE TRANSITION TO CONTINUOUS TRADING ON EMERGING FINANCIAL MARKET'S LIQUIDITY : CASE STUDY OF WEST AFRICA REGIONAL EXCHANGE MARKET (BRVM)

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SUMMARY

After 18 years of activities and take-off difficulties due to socio-economic and political environment of the WAEMU zone, the west Africa regional exchange market (BRVM)'s authorities decided to move to continuous trading. The decision was effective on 16th september 2013. This action, beyond the upgrading of this stock exchange market to international standards, aims at improving market liquidity. Two years after its implementation, it seemed interesting to question the relevancy of this decision.

In this empirical research, we are interested in ***evaluating the impact*** of the transition to continuous trading on market liquidity. Based on data collected from daily trading report and available databases, we mobilized the *instrumental variables* method to identify the part of the observed variation in liquidity due to the quotation mode change. This method was applied to evaluate the change in ***trading volume***, ***TurnOver ratio***, ***Martins index***, ***Amihud ratio***, ***Hui Heubel ratio*** and ***market impact*** due to quotation mode change.

It appears from this research that the multiplication by 2.5 of the monthly trading volume observed after the change is not only due to the transition to continuous trading. A similar conclusion can be made for other dimensions of liquidity. In addition, we realized that the impact is not uniform from one stock to another.

On the managerial level, the results of this research question the relevancy of the decision and its procedure. They open the way for a reflection on effective modalities for the establishment of a financial platform compatible to the WAMU zone development requirements. Theoretically, we contribute to financial theory debate on the link between quotation mode and the market liquidity, including the debate on the optimal organizational microstructure of financial markets**.**

Keywords: Financial market liquidity, liquidity indicators, instrumental variables, BRVM
JEL Classification : C510, D470, G120

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Introduction

The Council of the West African Monetary Union (WAMU)'s Ministers decided in december 1993 the creation of the Regional Stock Exchange[2]. One of the main objectives assigned to the WAMU stock market is to increase the savings rate and strengthen the companies' financial structure. Achieving these objectives depends heavily on the ability of the market to attract the regional institutions interested in the mobilization of resources from the financial market to finance their projects. It also depends on its ability to mobilize the sub-region and worldwide investors resources.

It started his operations on 16th September 1998 by three fixing quotation by week. After migrating to the daily fixing in 2001, the development of the West Africa Regional Stock Exchange has been hampered by political uncertainties, social environment induced by the long crisis in Ivory Coast which houses the headquarters.

The new authorities of the market have decided to give a violent push to its development through a new strategic plan that aims at positioning WAMU's stock exchange as the third of the continent by 2021. Among other actions, they decided to move the quotation from a daily fixing to continuous trading. The decision took effect on 16th september 2013, fifteen years after the first quotation. As announced by market authorities, the transition to continuous trading ambitioned to modernize the market and foster a large number of exchanges on the market. This decision is tipped to improve market liquidity and other benefits associated to this improvement. This decision by changing trading conditions in the market is likely to have an indirect influence on the determinants of market liquidity.

It seems necessary to shed light on the impact of this decision on market activities in order to provide an answer to the question: what changes in the West African Regional Stock Exchange's liquidity is due to the transition to continuous trading?

This research is threefold: strategic, conceptual and methodological. Conceptually, it allows to discuss on the influence of financial markets microstructure on its activities and its equilibrium. The debate on this influence on liquidity is omnipresent in financial theory, especially in the financial markets microstructure field. Methodologically, the research objective is to provide a methodology to rigorously evaluate the impact of a microstructure change.

Strategically, the results of this research should help to assess the potential gain resulting from this choice and identify its limits to ensure proper functioning of the West Africa regional financial market. It opens the way for the identification of other options which would allow authorities to achieve its objective in terms of improving the regional financial position on the continent.

[2]Final statement of the special session of WAEMU ministry council held on December 17th, 1993 at Dakar.
On 3rd July 1996, the WAMU ministry council adopted the Convention for West Africa Regional Exchange Market (BRVM)'s creation.
On 18th December 1996, preliminary works resulted in the legal constitution of the West Africa Regional Exchange Market (BRVM) and the Central Depository / Settlement Bank (DC / BR) ending the mandate given to the West Africa Central Bank (BCEAO) and the transfer of the project's implementation of these two organs.

We rely on a rigorous impact evaluation methodology that aims at controlling the other effects and bringing out the changes which are only due to the microstructure change.

To achieve this, we adopt a methodology which is composed of three parts. Firstly, we conducted a literature review on the theory and empirical market liquidity measure and study the link that can be established between the microstructure of a market and its liquidity. We collected thereafter data on trading volume and other characteristics of the listed securities on the BRVM to build useful indicators to measure financial market liquidity. These indicators are analyzed using descriptive statistics and econometric techniques to solve the problem set by the research.

The rest of the paper is organized as follows. In the first section, we present the literature review. The second section presents the methodology adopted. The reference model for the impact study is presented there. Section 3 presents the main results. We conclude with a discussion of the results.

1. Link between quotation mode and financial market liquidity : a literature review

The study of the relationship between securities returns, liquidity and financial market microstructure is an issue that animated a controversy in financial economics and prompted numerous researches. They were oriented in many directions and are interested in issues related to measuring market liquidity, the influence of microstructure on liquidity level and the existence (or not) of a liquidity premium in asset pricing.

The literature presents market liquidity as a multifaceted concept. For Biais et al. (1997) and Sarr and Lybek (2002), market participants perceive a financial security as liquid if it is possible to buy or sell quickly, supporting moderate transactions costs and reasonable price. This definition draws attention to the different dimensions of the concept of liquidity: transaction execution speed, cost and execution price (Garbade and Silber, 1979). Liquidity can be measured at a whole market level or by stock. Indeed, financial market liquidity depends on a the nature of the studied security (shares, bonds ...) which have different characteristics and therefore different liquidity magnitude; and other factors (Chordia et al., 2001 ; Fournier-Emonet, 2004).

Market liquidity is traditionally access via five key criteria (Sarr and Lybek, 2002 ; Bervas, 2006 ; Goyenko et al., 2009 ; Foucault et al., 2013) : *Rigidity* (proximity between bid and ask price) ; *depth* (ability to absorb a large amount of order flows), *immediacy* (speed with which orders are executed), *width* (the existence of potential demand and supply around the equilibrium) and *resilience* (the speed with which the price returns back to their equilibrium after a shock in transactions flow). An efficient measure of liquidity should take into account these criteria. Base on the impossibility to get a single indicator to measure all these criteria, empirical studies have considered a variety of measures. Each of them aims at measuring a particular aspect of market's or security's liquidity. We present in the methodology section the selected liquidity indicators.

Evaluating the impact of microstructure change on market liquidity is not a new issue. It helps to enrich the debate on the measurement and determinants of financial market liquidity.

The literature on market microstructure shows a large variety of methods for financial markets quotation organization. The differences are related to the price quotation method, transmission and execution mode, the role of intermediaries or the information available for participants during the trading sequence. This diversity has spawned a vast literature whose main directions concern the relationship between the market microstructure, its efficiency and its liquidity. The studies that addressed the effects of market microstructure on liquidity level were particularly interested, among others, to study the impact of quotation mode.

The study of the relationship between the microstructure of a market and its liquidity level is a financial theory field that received many contributions; including the work of Garbade and Silber (1979) and Grossman et Miller (1988). The first proposed a formal analysis of the choice of the optimal market microstructure; particularly, on the issue of fixing frequency. They established that *''the fixing frequency should be greater when the volatility of the underlying asset value is large and / or the average number of orders sent to the market for a given time interval is important''.* The second contribution point on the influence of the demand for immediacy on the market liquidity. It concludes that higher demand for immediacy increases market liquidity. A corollary of this result is that a continuous time market driven by investors who have a high demand for immediacy is more liquid than another.

We note, moreover, that the efforts of emerging stock exchanges to modernize their quotation system, have generated interest in literature. These studies have developed empirical tests of the impact of the continuous trading on securities liquidity. Amihud et al. (1997) investigated the case of the Tel Aviv stock market. The authors studied the effect of the transition to continuous quotation on securities' liquidity. They conclude that continuous quotation improved market liquidity by inducing a permanent increase in stock prices in the magnitude of 5% and a significant improvement in trading volume.

These findings were confirmed by the results of Kairys et al. (2000) and Lauterbach (2001). These two studies compare continuously quoted securities' liquidity and those in fixing on the same market. They demonstrated that continuous trading has a beneficial effect on most traded securities. This is not the case for lest liquid securities. Emerging markets are characterized by a strong focus on a limited number of active assets, then the authors advocate the adoption of a differential quotation mode according to observed liquidity level. For a given stock, the quotation mode used depend on its liquidity before the decision like what has been done at Euronext Paris in 2007.

The link between trading frequency and market liquidity is a relationship that nourishes a debate in the financial markets microstructure literature. Indeed, the direction of influence is not

uniform. Indeed, Biais et al. (1997) show that the use of continuous-time trading has a double and opposite effect on liquidity. Chang et al. (1998) presents a review of some contributions to this controversy.

In a continuous market, participants tend to leave their order flow throughout the quotation period. This strategy can lead to an insufficient quantities offered or requested. Thus, a participant who places an order with a large volume may be obliged to accept a widely prices variation. A continuous market may therefore be less liquid than fixing market. While in principle the exchanges on a continuous trading market are supposed to be faster.

In a fixing market, by accumulating buy and sell orders, the clearing price is likely to be established near the equilibrium price. Thus, if there is an important order flow around the equilibrium price, it is likely to be offset by orders in the contrary direction. In this sense, Barclay et al. (2008) show that the orders consolidation is a mechanism that is necessary to insure that trading are done at efficient prices; in particular in a period of liquidity shocks. Thus, fixing market may be more resilient than continuous market (Garbade and Silber, 1979).

From this double implication, the authors recommend to the markets authorities an efficient improvement of market liquidity strategy. This strategy should combine the efficiency of the fixing while keeping the benefits of orders accumulation with fixings frequency increase. Making the appropriate trade-of will help to balance the disadvantages of sellers or buyers disappearance in the market at any moment.

Kalay et al. (2002), build on the experience of Tel Aviv Stock Exchange transition to continuous quotation, studied its influence on the securities' liquidity. Their results have been desegregated between the large and small companies (size measured by market capitalization). Their results confirm the positive impact of the quotation mode change on market liquidity; it also shows that big companies' share benefitted most from this change. In addition, the procedure has an influence on the liquidity change. They demonstrated that the direction of changing depends on the choice of shares which transited to continuous trading. It depends on the strategy if the shares of small cap companies are moved to continuous trading or not. They demonstrate that there are some inconsistencies regarding the effects of the trading mode change. The authors conclude that investor preference plays an important role in this liquidity change. Indeed, they established that investors have a preference for markets that operate continuously. The increase in trading volume could be due to the attraction of new investors.

Another interesting result of the impact of continuous time transition on the securities liquidity is that it is not uniform across all assets. Indeed, Kairys et al. (2000) from the analysis of the Riga[3]

[3] Latvia Stock Exchange market.

Stock Exchange quotation change established that liquidity has been improved for securities that were liquid before the change but deteriorated for securities that were less liquid before the change. Their contribution opens a new perspective in the debate on the link between the quotation mode on market liquidity.

We can keep in mind that the debate on the influence of the quotation mode on liquidity is not a ruling. The direction of influence depends on procedure, market characteristics, characteristics of the securities involved, the environment and structure of participants' preferences.

The last point in the literature is related to the issue of the existence (or not) of a security (il)liquidity premium. Indeed, in an environment in which investors have a preference for liquidity, they will accept to invest in securities with low liquidity level if they report it had superior performance comparing to the others. It follows from this reasoning that there is an illiquidity premium in asset pricing.

This debate over the link between the price (or equivalently the yield) and security liquidity has been initiated by Stoll (1978a, 1978b), Amihud and Mendelson (1986), Kyle (1985) and Glosten and Milgrom (1985) and experienced enrichments provided by Holmstrom and Tirole (1998), Amihud (2002) ; Chordia and al. (2002), Pastor and al. (2004) et Chordia and al. (2009). The results of these studies are relatively mixed and continue to benefit from findings which tend in confirming (or denying) the existence of a liquidity premium. In this research, we don't address this issue but it seems important to keep it in mind when we work on the importance of market or securities liquidity.

2. Methodology

The methodological challenge of this research is to estimate the contribution of microstructure changes on market liquidity. Indeed, the works of economists and statisticians have shown that a simple comparison of liquidity indicators before and after change is not enough to evaluate its contribution to the liquidity change. This approach is prone to bias towards the denied of the change's effect or overestimates microstructure change contribution. The choice of the impact evaluation process is essential to ensure that these biases are controlled. In our case, we use the impact evaluation method: instrumental variable[4].

[4] The instrumental variable method was initiated by Durbin (1954) and Sargan (1958). It aims at controlling the endogeneity bias induced by systematic differences on exogenous parameters before and after the change. In our situation, we used this approach to deal with the differences between the trading days (or months) characteristics before and after the change. This approach helps us correct the biases resulting in a naïve comparison of the situation before and after the transition.

The second challenge of the methodology is to select the most relevant liquidity indicators. Indeed, the literature states that the market liquidity is multidimensional and that there is a wide variety of indicators to measure each dimension. Another key point is about the mobilized data in this empirical study.

2.1 The data

The data used in the study were collected from BRVM's website. They had been treated to help us compute the useful daily and monthly basis liquidity indicators. In this section, we present the key points related to this issue.

2.1.1 The basic data

We mobilized the data on securities trade in the secondary market of the WAMU regional Exchange (BRVM). These are available on its website through Daily Market Report (BOC). They were captured, compiled and processed to provide useful data for analysis. After this step, we get data on:

- ✓ the trading volume and value exchange each day by securities and on aggregate level;
- ✓ the stock price and its changes day by day.

For the purposes of this analysis, we limit ourselves to the data covering the period January 3rd, 2005 - October 31st, 2015. Note that it was not possible to reconstruct the data for all trading days on the period. Thus, out of the 2626 trading days on the period, there are 35 missing trading days, that to say a missing rate of 1.33%. This rate is relatively low and insure us that the database have sufficient coverage to allow a meaningful analysis. We also made overall consistency checks to ensure that the data meet a minimum quality.

Over the period, we counted forty-five (45) companies whose shares are listed on the secondary market BRVM. Some of these stocks are written off the exchange market (exit of some companies, merger and acquisition ...) or were on the market during a period which does not allow to compute their liquidity before and after the microstructure change (eg Total Senegal, listed after the change).

So we made a selection of securities eligible for analysis. We kept thirty-four (34) shares. For each stock, we have basic information (Market value, number of securities traded ...) and daily information on the securities (number of securities outstanding ...). We have aggregated market information on the global market level (trading volume, indices values, market capitalization,

number of outstanding shares ...). At the end of this step, we get an unbalanced daily and monthly panels[5] that allows us to build liquidity indicators.

2.1.2 BRVM liquidity measure

We study the liquidity at two levels: the global level and on available stock level. We keep seven indicators to measure market liquidity. These are: ***trading volume***, ***turnover ratio***, ***percent of days without transaction***[6], ***Martin index***, ***Amihud ratio***, ***Hui Heubel ratio***, ***market impact*** and ***transaction cost.*** Table 1 present a short description of these indicators.

Table 1: A definition of liquidity measures

N°	Outil	Formule	Auteur
1	Trading volume	$V_{i,t} = \sum Q_i$	Bhushan (1994)[7]
2	Turn Over Ratio	$TOR = \frac{V}{S * P_{moy}}$	Kerry Cooper et al. (1985)
3	Mesure de Lesmond, Ogden, and Trzcinka (LOT)	Frequency of trading days without transaction	Lesmond, Ogden, and Trzcinka (1999) [8]
4	Amihud ratio	$Am = \frac{1}{T}\sum_{t=1}^{T}\frac{\lvert r_t \rvert}{V_t}$	Amihud (2002)
5	Hui Heubel ratio	$HH = \frac{\frac{P_{\max} - P_{\min}}{P_{\min}}}{\frac{\sum_{i=1}^{T} P_{it} Q_t}{S * \overline{P}}}$	Vayanos and Wang (2012)
5	Martins index	$IM = \sum_{i=1}^{T}\frac{(P_t - P_{t-1})^2}{Q_t}$	Gabrielsen et al. (2011)

V : Trading Volume at date t S : Outstanding shares P_{moy} : Share average price
r_t : return on date t T : period of interest (e.g. the month)

The *trading volume* measures the market's ability to absorb high demand or offer. It is complemented by the *turnover ratio*. Indeed, because of the severity of the WAMU's market

[5] We get panel data in which individual are listed companies' shares and date are the trading days and the month on this period. The panel is not cylindered because some companies have been introduced after the panel starting date.
[6] It is computed as the percent of day without transaction. It measures complementary of the probability of having an exchange on a given security or market.
[7] Cité par Vayanos and Wang (2012), p. 54
[8] Cité par Vayanos and Wang (2012), p. 54

illiquidity, this indicator is more suitable (Lesmond et al., 1999). As for the turnover ratio, it helps us assess the proportion of shares that are actively traded in the market. We adjoined three indicators which measure respectively the sensitivity of prices on demand (Amihud ratio, Martins index and Hui Heubel ratio). These three indicators complement to measure the impact of demand or supply on the stock prices for a given stock and the overall market. For a discussion on the definition and interpretation of each indicator, the reader can refer to Sarr and Lybek (2002).

The first five indicators are calculated on a monthly basis. They are used for a descriptive analysis of liquidity evolution and to study the impact of the trading mode change on the overall liquidity by relying on econometric analysis.

For the last two, we relied on daily data and adopted a modeling framework detailed later.

After the computations, we have three sets of data:

- monthly data related to BRVM's liquidity;
- monthly data on the liquidity by BRVM listed company;
- daily data on BRVM listed company's liquidity.

In addition to the market and securities liquidity measures, there are additional variables that presents the quotation dates characteristics before and after change, we added information on the *year, month, market capitalization, number of listed company, stock prices* and *their variation, stock index* and its *variation.*

2.2 Impact evaluation methods used

Impact evaluation methodology are designed to estimate following term :

$$Impact\ (Change) = E\ (Liquidity \mid With\ change) - E\ (Liquidity \mid No\ change)$$

This term is the translation of the difference between the prevailing market liquidity and market liquidity if there had been no change of microstructure. The first component is observable and can be assessed by calculating the indicators that are listed above. The second component is unknown and needs to be estimated. Equivalently, the difference can be directly estimated. Different frameworks (Difference in difference, Matching, …) are available to measure the impact of quotation mode change on the market indicators and can be used to be applied to the WAMU regional stock exchange. The choice between them depends on how the change was implemented, the data available and the timing of the implementation of the impact evaluation. The circumstances of our study command the use of instrumental variables.

2.2.1 Approach to evaluate impact of the change on market's depth, resilience and immediacy

Instrumental variables method is used to estimate the parameters of the equation:

$$\mathbf{Liq_{i,t} = f(T_{i,t}, Z_{i,t}, \varepsilon_{i,t}) \quad avec\ \varepsilon_{i,t} \approx N(0, \Omega_{i,t})} \qquad \mathbf{(1)}$$

$Liq_{i,t}$: liquidity indicator of stock i at time t

$T_{i,t}$: Dummy variable equal to 1 after the change and zero before

$Z_{i,t}$: instrumental variables

A priori, we assume a linear influence of the quotation mode change on market liquidity. Thus, we can rewrite equation (1) as follows:

$$\mathbf{Liq_{i,t} = \alpha_i + \beta_i T_{i,t} + \varepsilon_{i,t}} \qquad \mathbf{(2)}$$

The term $\varepsilon_{i,t}$ includes all other factors that may influence market liquidity but that are not explicitly considered in this equation and the parameter β_i measure the impact of the trading mode change. It can be estimated by maximum likelihood or Less Ordinary Squares (OLS) if the basic assumptions of the linear model are validated; including the exogeneity. In the particular case of our study, this hypothesis means that other factors that could influence liquidity have the same distribution before and after the quotation mode change. This assumption has low chance of being consistent. In this situation, the estimation of β_i by Ordinary Least Square (OLS) or maximum likelihood is biased (under- or over-estimation of the impact of the trading mode change on liquidity). The use of instrumental variables method can test this assumption and consider a more efficient estimation framework.

It consists of identifying a group of liquidity determinants variables (Z-instruments) that changes significantly since the change not explicitly taken into account in the model. Formally, instrumental variables must satisfy the following conditions:

$$\mathbf{Cov(Z_{i,t}, T_{i,t}) \neq 0} \qquad \mathbf{(3)}$$

$$\mathbf{Cov(Z_{i,t}, \varepsilon_{i,t}) = 0} \qquad \mathbf{(4)}$$

We discuss the choice of instruments and test results of their validity in section dedicated to the results. There are several estimation methods whose implementation can be made with STATA reg3 module[9].

This approach is, however, applicable only to five indicators of market liquidity that is calculated explicitly. These are *trading volume, turnover ratio, Martin Index, Amihud ratio and Heubel Hui ratio.* It is however not applicable to the impact evaluation of the trading mode change on the *market impact* and *transaction costs.* We adopted a complementary analytical framework.

2.2.2 Framework for impact evaluation of the quotation change on *market impact* and *transaction costs*

To evaluate the impact of the trading mode change on the market impact and transaction costs, we use a framework similar to that proposed by Lesmond et al. (1999). Explicitly, we can translate the problem of evaluating the impact of microstructure change on liquidity through the following system of equations:

$$R_{i,t} = \begin{cases} R^*_{i,t} & si \quad R^*_{i,t} \le c^a_{i,t} \\ 0 & si \quad c^a_{i,t} \le R^*_{i,t} \le c^v_{i,t} \\ R^*_{i,t} & si \quad R^*_{i,t} \ge c^v_{i,t} \end{cases} \tag{5}$$

$$V_{i,t} = \begin{cases} V^*_{i,t} & si \quad V^*_{i,t} > 0 \\ 0 & \text{sinon} \end{cases} \tag{6}$$

$$P(V_{i,t} = 0) = \frac{1}{1 + e^{-Y^*_{i,t}}} = 1 - P(V_{i,t} > 0) \tag{7}$$

Avec

$$R^*_{i,t} = \alpha_0 + \rho_1 T_{i,t} + (\beta_1 + \beta_2 T_{i,t}) R_{m,t} + (\lambda_1 + \lambda_2 T_{i,t}) \log(V_{i,t}) + \varepsilon^1_{i,t} \tag{8}$$

$$Log(V^*_{i,t}) = v_0 + v_i + \rho_2 T_{i,t} + \varepsilon^2_{i,t} \tag{9}$$

$$Y^*_{i,t} = Y_i + \rho_{3,i} T_{i,t} + \varepsilon^3_{i,t} \tag{10}$$

$$c^a_{i,t} = c^a_i + a_1 T_{i,t} + \varepsilon^4_{i,t} \tag{11}$$

$$c^v_{i,t} = c^v_i + v_1 T_{i,t} + \varepsilon^5_{i,t} \tag{12}$$

$R_{i,t}$: return of stock i at time t
$R_{m,t}$: market return at time t
$c^a_{i,t}$: implicit cost of buying the stock i at time t
$c^v_{i,t}$: Implicit cost of selling the stock i at time t

[9] http://www.stata.com/manuals13/rreg3.pdf

$V_{i,t}$: trading volume stock i at time t

$T_{i,t}$: Dummy variable equal 1 after the change and 0 before

The first equation (5) reflects the price dynamics of each asset. It is borrowed from Lesmond et al. (1999) who suggested a TOBIT model for studying the dynamics of asset prices in the market. Indeed, in this configuration $c^a_{i,t}$ and $c^v_{i,t}$ represent transaction costs that limit the gain that can motivated a security buy or sell. These costs reduce market liquidity.

Note however that the initial formulation is not entirely comparable to a Tobit model. We propose a processing and decomposition of the equation (5) as follows:

$$R^-_{i,t} = \begin{cases} R^*_{i,t} & si \quad R^*_{i,t} - c^v_{i,t} \leq 0 \\ 0 & si \quad R^*_{i,t} - c^v_{i,t} \geq 0 \end{cases} \qquad \textbf{(13)}$$

$$R^+_{i,t} = \begin{cases} R^*_{i,t} & si \quad R^*_{i,t} - c^a_{i,t} \geq 0 \\ 0 & si \quad R^*_{i,t} - c^a_{i,t} \leq 0 \end{cases} \qquad \textbf{(14)}$$

In these equations R + (resp. R-) represent two variables which are equal to the return when it is positive (resp. negative) and equal 0 otherwise. This transformation and decomposition helps to bring a framework whose parameters can be estimated using multidimensional Tobit models. The whole system is comparable to a Tri-Tobit model whose estimation is made according to the approach suggested by Newey (1987) and implemented under the STATA ivtobit module.

Furthermore, we assume that the equilibrium price is sensitive to trading volume (8). The parameter λ reflects price sensitivity to trading volume. This is the Amihud liquidity measure. The market is more liquidity since this parameter is close to zero; thus, an investor can intervene in the market to buy or sell a relatively high quantity of stock without significantly influence the equilibrium price. Its value translates the market depth. When it is high, an investor suffers large changes in stock price when he wishes to acquire it.

The parameter α reflects the autocovariance of price dynamics which reflects their ability to return to its equilibrium value after a demand or offer shock. It reflects Roll (1984) liquidity measure which established that under certain assumptions the price changes autocovariances reflects the transaction costs on a market.

We explicitly included the dummy variable representing the microstructure change to reflect its influence on the parameters. Thus, each parameter has two components. The second reflects the potential effect of microstructure change.

The second equation (9) reflects the dynamics of the market daily traded volume. For each parameter, it is explicitly assumed that its reflect the influence of microstructure change, an

individual effect of each stock (this parameter capture the individual effects of securities not included explicitly in the model), the influence of the equilibrium value variation on the stock traded volume. As for the equation reflecting the equilibrium price dynamic, we consider the influence of microstructure change on these parameters by integrating the dummy variable.

The last equation (7) indicates the probability of not having exchange ($V_{i,t} = 0$). It is estimated independently by the stata ivprobit module.

The system of equations (6) - (14) provides the analytical framework for estimating the influence of the trading mode change on the daily liquidity.

At the end of this section, we have an overview of the methodology used in the study. We can go through the principal results.

3. Results

In this section, we present the research results, divided into three sections. We first analyze the impact of change on global liquidity. Next, we present the results of the impact evaluation by stock. We conclude with the impact evaluation of the daily liquidity.

3.1 Analysis of the impact of continuous trading on BRVM's overall liquidity

using five liquidity indicators to catch the specificities of the impact set a problem of more suitable framework to estimate the parameters. Explicitly, we need to decide if the impact can be estimated equation by equation or by simultaneous estimation. The first technique is consistent if the indicators are not related. To find the right framework, we start by studying the interrelations between these indicators. Moreover, this preliminary analysis ensured us that we do not base the analysis on redundant indicators and helped to justify the use of simultaneous equations method. The principal Component Analysis (PCA) shows that the liquidity indicators are strongly correlated and not redundant and can be structured according to three principal components that count for 87% of the inertia of the cloud. This result justifies the use of simultaneous equation estimation for the estimation of the impact of quotation mode change on market liquidity.

We relied on natural instruments that are: *market return*, *number of listed companies*, *market capitalization*, *number of trading days in the month*, *month of the year*, *the previous period*

Table 2: Impact of the trading mode change on BRVM's overall liquidity

This table shows the results of impact estimation of the trading mode change on overall market liquidity. These estimations were made with Stata reg3 module. The results are presented in block. The upper part shows the basic econometric indicators to judge the significance of the impact of the change on each of the five liquidity indicators. The lower block respectively presents the estimations of the impact on each of the indicators accompanied with conventional indicators to judge the significance of each coefficient.

Equation	Obs	Parms	RMSE	R-sq	chi2	P
Trading volume	128	1	0.893	0.079	80.620	0.000
TurnOver ratio	128	1	0.002	-0.076	14.620	0.000
Martins index	128	1	0.414	-0.008	3.180	0.075
Amihud ratio	128	1	1.549	-0.019	31.430	0.000
Hui Heubel ratio	128	1	2.380	-0.013	7.230	0.007
Trading volume[(a)]	**Coef.**	**Std. Err.**	**z**	**P-value**	**[95% Conf. Interval]**	
CotationMode[(b)]	2.072	0.231	8.980	0.000	1.620	2.524
intercept	8.168	0.091	89.870	0.000	7.990	8.347
Turn Over ratio	**Coef.**	**Std. Err.**	**z**	**P-value**	**[95% Conf. Interval]**	
CotationMode[(b)]	0.002	0.000	3.820	0.000	0.001	0.002
intercept	0.002	0.000	10.620	0.000	0.001	0.002
Martins Index	**Coef.**	**Std. Err.**	**z**	**P-value**	**[95% Conf. Interval]**	
CotationMode[(b)]	-0.191	0.107	-1.780	0.075	-0.400	0.019
intercept	0.097	0.042	2.300	0.021	0.014	0.179
Amihud Ratio	**Coef.**	**Std. Err.**	**z**	**P-value**	**[95% Conf. Interval]**	
CotationMode[(b)]	-2.245	0.400	-5.610	0.000	-3.029	-1.460
intercept	1.351	0.158	8.570	0.000	1.042	1.660
Hui Heubel Ratio	**Coef.**	**Std. Err.**	**z**	**P-value**	**[95% Conf. Interval]**	
CotationMode[(b)]	-1.654	0.615	-2.690	0.007	-2.859	-0.448
intercept	0.913	0.242	3.770	0.000	0.438	1.388

Endogenous variables: LogVolTrans TurnOver IndiceMartins RatioAmihud RatioHuiHerbel Treat
Exogenous variables: F1 F2

(a) Expressed in log **(b) dummy variable of trading mode change equal 1 after and 0 before**

market performance, *the previous period trading volume* and the *previous turnover*.

An analysis of the relevancy of each instrument was made at a first level. It concluded that only *market capitalization*, *number of listed company*, *the previous period trading volume* and *the previous period turnover* are valid instruments to control the endogenous bias; at least when we considered them individually. In the impossibility to perform the comparison tests of the relevancy of the instruments two by two, we opted to replace these variables with the factors of a

Principal Components Analysis (PCA) on them[10] . We used a descent approach. Initially the five factors are used as instruments. We perform thereafter a Sargan test. In case of the null hypothesis rejection, the last factor is removed. The test is done on model with the remaining instruments. The application of this approach led us to keep two factors.

The impact estimation of the trading mode change on liquidity is made using as instruments the two synthetic variables (factor 1 and 2). The results are shown in Table 2 above.

It appears from these results that the trading mode change had a significant influence on the market depth. It doubled the trading volume and increased the turnover ratio by 0.2%. At the same time, it improved the market resilience. Insofar as the Amihud ratio and Hui Heubel ratio fell respectively by 2.2 and 1.6 points. Thus, since the trading mode change, the market is less prone to extreme changes when faced with a relatively large stock offer or demand.

In quantitative terms, the comparison of these results with a naive estimations conclude that the magnitude of the impact on market depth is lower than the idea that we could be built when we naively compare indicators before and after trading mode change. For example, the monthly trading volume was multiplied by 2.5 when comparing its average before and after the change.

An analysis at the submarkets, stock by stock, is necessary to deeper our knowledge on the dynamics at a disaggregated level.

3.2 Homogeneity of the impact of the trading mode change on liquidity

In this section, we focus on the analysis of the specificities of the impact of the trading mode change on market liquidity by listed company. We keep the same liquidity indicators at stock level. However, we dropped Martins index. Because when it is calculated by stock, it provides a heterogeneous result. We have drop it as a liquidity measure on stock level. The other two market resilience indicators allow us to capture the impact of the trading mode change on this liquidity component. We added the *frequency of days with transaction* to reflect the immediacy, another dimension of stocks liquidity. All these indicators are measured on a monthly basis.

The results are divided in two parts. We firstly study the individual effect by stock and thereafter we study the influence of the liquidity before the change on the magnitude of the impact.

[10] We conducted a principal component analysis (PCA) taking as active variables: the quotation variable (indicator that is 1 after transition and 0 before), market capitalization, number of listed companies, the number of shares traded in the previous period and trading volume in the previous period. The first factor, with 61% of the inertia, resumes the structural information on the multiple links between these variables. This strategy allows us to build an instrumental variables block highly correlated with the treatment variable and the selected instruments.

3.2.1 Impact of the quotation change on individual stock market's liquidity

To achieve the objectives of the section, we use a similar approach to the analysis of the impact of the trading mode change on the overall liquidity. Based on the conclusions of the previous section, we adopt a simultaneous equation model to take into account the multiple possible links between indicators.

We used ten "natural" instruments: *number of outstanding shares*, *market capitalization*, *stock inclusion into BRVM10*[11], *stock return*, *market return*, *stock price movement*, *stock previous returns*, *market previous return*, *number of trading days in the month* and *month of the year*.

Based on these instruments, we estimated a simultaneous equation model with the five liquidity indicators as objective variable and the dummy variable of the trading mode change as explanatory variable. We included a fixed effect for each stock to capture the specificities of the impact by stock. We test subsequently the relevancy of the instruments with a Hausman test. For obvious reasons of space limitation, the results of these analysis are not reported in the document. The complete output of the analysis can be obtained from the author on request. The presentation is limited to the significance test of different liquidity indicators are shown in Table 3 below.

Table 3: Evolution of BRVM's liquidity

Equation	Obs	Parms	RMSE	R-sq	F	P
Trading volume	3984	72	1.63	0.63	95.02	0.0000
Turnover Ratio	3984	72	16.11	0.01	0.53	0.9996
No trading day frequency[(a)]	3984	72	0.18	0.66	105.72	0.0000
Amihud ratio	3984	72	3355.89	0.18	12.19	0.0000
Hui Heubel ratio	3984	72	110.90	0.10	6.32	0.0000

[(a)] For a given month and listed company, the no trading day frequency is percentage of exchange day during which there was trade on the share.

It appears from this table that at the stock level, the quotation mode change induced a significant change of all liquidity indicators except *Turnover ratio*. So we can conclude that change in terms of trading volume and the Amihud ratio observed in the global market analysis is consistent with the behavior of stocks. Thus, except for seven stocks (Bank of Africa CI, NESTLE CI, SAFCA CI, CROWN SIEM CI, SOGB CI, SAPH CI and UNILEVER CI) trading volume has grown up

[11] Note that the BRVM 10 index reflects the average price performance of the most liquid stocks. Its composition is reviewed quarterly. The variable equal 1 if the stock is in the index and 0 otherwise. We take into account the possible influence of the stock inclusion in this index on its liquidity.

since the transition to continuous trading. This result tells us that the market depth moved up at least regarding the ability of the individually stock to absorb a relatively high supply or demand.

Similarly, the overall result regarding the lack of turnover ratio's evolution is also noticeable at the sub-markets, defined by stock. When combined with the previous results, we can conclude that the evolution of the stock sub markets depth is not due to the change in the securities' turnover but rather to the increase in the number of outstanding shares or stock prices.

In the same direction, we observe that the frequency of days with trade has also grown up for overall stock. With the exception of Bank of Africa Benin for which this indicator has declined and the situation of Ecobank Transnational Incorporated, SAFCA CI, Sonatel SN and SITAB CI for which it has not significantly change. We can therefore conclude that the immediacy of the individual sub-market is improved. Let's note Ecobank Transnational Incorporated, Sonatel SN and SITAB CI are companies whose shares were subject to regular exchange before the change. It is not surprising that the probability to register an exchange every day, already high, has not improved comparing to its level before the quotation mode change.

In contrast, the Hui Heubel ratio who did not show a significant change at the global level, has been increased for some stocks since the p-value of the comparison test is less than 0.005. Further analysis shows that only SOLIBRA CI situation has improved regarding this indicator.

So we can learn from this detailed analysis stock by stock that changes in liquidity following the trading mode change has specificities per share. It is not uniform across stocks.

3.2.2 Influence of pre-change liquidity on the magnitude of the impact

We are interested in the analysis of the interaction between changes in liquidity before and after microstructure change in order to question the validity of Kairys et al. (2000) results [2]that showed on the Riga that the influence of the quotation mode change is not uniform; and that it has a higher impact for securities that were more liquid before the change. To achieve this, we do a meta-analysis of the correlation between the liquidity level before and after the change; the latter is measured by the regression coefficient if it is significant and 0 otherwise.

From these data, we evaluate the correlation level. The results of the analysis are presented in Table 3 below.

Table 3: Interrelation between listed companies' liquidity level before and after change

The table presents the results of correlation analysis of liquidity before and after trading mode change. We don't show the upper values to the first diagonal because the matrix is symmetric.

		Trading volume		Turnover Ratio		Trading frequency		Amihud Ratio		Hui Heubel Ratio	
		Before	After	Before	After	Before	After	Before	After	Before	After
Trading volume	Before	1									
	After	**-0.34**	1								
Turnover Ratio	Before	0.45	-0.24	1							
	After	-0.45	0.24	**-1.00**	1						
Trading frequency	Before	0.85	-0.14	0.37	-0.37	1					
	After	-0.31	0.75	-0.26	0.26	**-0.21**	1				
Amihud Ratio	Before										
	After	0.16	0.00	-0.04	0.04	0.06	0.15		1		
Hui Heubel Ratio	Before	0.01	0.24	0.03	-0.03	0.12	-0.10		0.04	1	
	After	-0.05	-0.07	0.03	-0.03	0.16	-0.12		-0.08	**-0.03**	1

It appears from this table that, in average, there is a negative correlation between the amplitude of change and the liquidity level before the implementation of the decision since all the correlation coefficients are negative. It therefore appears that in the case of the BRVM, trading mode change has not only helped to strengthen the liquidity of the most liquid stocks but improved significantly the liquidity of less liquid stocks.

This result leads to the conclusion that this is a decision that contributed to the strengthening of the monthly market liquidity both in overall terms and stocks individual market.

Thus, the impact of the trading mode change on BRVM's liquidity has followed a different dynamic from that of the Tel Aviv stock exchange. Liquidity increase did not benefit to the most liquid stocks before the change. It benefited most to least liquid stocks before the change. We therefore approved the initiative and the way of proceeding by extending the measure to all stocks. This choice could be subject to debate since other markets have chosen another options in the implementation of the trading mode change; including upgrading to continuous trading the most liquid stocks.

To enable us to refine our results, we focus on daily liquidity.

3.3 Impact of trading mode change on the market impact

The last session of our analysis focuses on the impact evaluation of the trading mode change on the daily liquidity. This is based on three liquidity indicators: *frequency of exchange day with*

trading, *trading volume* and the *impact of market.* These indicators are evaluated on a daily basis. Note that it was not possible to estimate efficiently the *transaction costs*. Indeed, the implementation of the analytical framework presented through equations (6) - (14) does not allow simultaneous identification of alpha coefficient, characteristics of the securities in the market model (8) and stock transaction costs (equation 13 and 14). We therefore made an overall estimation. We use the same tools as the previous section.

Tables 4, 5 and 6 (in appendix) present the estimations. Note that these tables present an extracts of the overall results. They are limited to estimation of the impact change parameters.

From Table 4, we can conclude that the transition to continuous trading has globally improved the frequency of trading days for the majority of the stocks. Indeed, for about two thirds of the stocks retained in the analysis, the impact is significant and positive with major impacts for Sonatel SN, ETIT TG and BOA BENIN. Note, however, that the transition to continuous trading has reduced the probability to register a trade on around one third of the stocks; including SICOR CI and SETAO CI. The change has no impact on the probability to register an exchange for SICABLE CI. From the analysis of individual stock behavior before change, we realized that stocks that have most benefited from the trading mode change (in terms of increasing the likelihood to observe an exchange per day) are those with a relatively high level of liquidity before the quotation mode change.

The number of shares traded during a transaction day has increased. with the exception of six stocks (CFAO CI, NESTLE CI, SAFCA CI, CROWN SIEM CI and SETAO CI) whose trading volume have not significantly changed; and four stocks (SICOR CI, SAPH CI, SIVOM CI, and UNILEVER CI) whose trading volumes has decreased. Two-thirds of listed companies have registered an increase of their daily number of traded shares.

A combination of this result with the previous, we conclude that for around two third of the stocks, the quotation mode change resulted in an increase in the frequency of exchanges and number of traded shares during an exchange session. This could explain the impact of the change on trading volume.

This does however not overshadow the situation of companies whose immediacy and depth were adversely impacted. The situation of SICOR CI, SAFCA CI and CROWN SIEM CI raise a need of specific attention. The quotation mode change resulted in a reduction of the frequency of exchanges and the number traded share in case of transaction. Between the two extremes, we can

recall that there are some stocks for which quotation method change resulted in an improvement in the frequency of trade but not the increase in trading volumes (CFAO CI, NESTLE CI ...); or improved trading volume but not the frequency of trade (SICABLE CI ...).

We can conclude that the quotation change had a diverse impact on the immediacy and depth of the BRVM stock market. Further research could help to shed light on the explanation of heterogeneity of impact.

Regarding the stocks market resilience, measured by the market impact, the vast majority (22 out of 34) of stocks are characterized by a lack of change in market impact. The third of listed companies saw their resilience improved insofar that the change has induced the decline of market impact coefficient. For two of them: TRACTAFRIC MOTORS CI and BOLLORÉ AFRICA LOGISTICS CI, market impact increased after the trading mode change. They have therefore lost resilience. Incidentally, the transaction costs decreased significantly. Resilience before the change does not explain the nature of the impact on resilience. Indeed, among the two stocks whose resilience has declined BOLLORÉ AFRICA LOGISTICS CI had strong resilience before the change; at the opposite of TRACTAFRIC MOTORS CI which had low resilience before. In this study, we don't explore the explanation of such heterogeneity.

This section allows us to close the presentation of the results and leads to the conclusion.

Conclusion

We wanted through this study to conduct an exploratory study of the possible impacts of the microstructure change of the West Africa Regional Stock Exchange Securities since september 16th, 2013 on trading activity aftermarket. We particularly focused on its impact on market liquidity. Understanding the possible impacts of this change is important to assess its role in achieving the objectives set by the authorities and should open the debate on the additional resources needed to achieve the desired objectives through the new strategic plan. And beyond, it helps us in identifying actions that can be considered to allow the financial sector to bring a significant contribution to the financing of value creation in the region and in Africa.

We established that globally the change has improved market depth as anticipated by the authorities; at least if we limit its impact on the market's ability to absorb important offer or demand. Similarly, the market become more resilient. Note, however, that the circulation of the securities has not changed significantly and remains very low. We conclude that this strategy alone is not enough to significantly improve liquidity, guaranteeing efficient operation. It is

appropriate to consider further actions including encouraging active portfolio management. Indeed, Jarnecic and Snape (2014) established the key role of high-frequency traders in market liquidity magnitude establishment.

Analysis by stock allowed us to focus on the specific impact by stock. It revealed that globally the trading mode change has contributed to the increase of the frequency of daily trade, the trading volume and reduced market impact. We establish that the less liquid shares before the change benefited the most from the trading mode change.

These results are only those of an exploratory study that needs to be enriched by deeper analysis that should mobilize more elaborate frameworks and more complete data included the professionals' opinions, preferences and perceptions.

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Appendices:

Further results on the quotation mode change impact evaluation on BRVM liquidity

Table 4: Estimated impact on the probability to register a transaction during a session

Two-step probit with endogenous regressors				Number of obs	=	88861
				Wald chi2(67)	=	19255.17
				Prob > chi2	=	0.0000
Symbole	**Coef.**	**Std. Err.**	**z**	**P>z**	**[95% Conf.**	**Interval]**
BICC	0.52	0.04	12.55	0.0000	0.43	0.60
BNBC	0.16	0.04	4.04	0.0000	0.08	0.24
BOAB	1.30	0.04	30.43	0.0000	1.22	1.39
BOABF	0.73	0.06	12.38	0.0000	0.61	0.84
BOAC	0.76	0.05	14.06	0.0000	0.66	0.87
BOAN	0.42	0.04	10.12	0.0000	0.34	0.50
CABC	*0.04*	*0.04*	*0.92*	*0.3600*	*-0.04*	*0.12*
CFAC	***-0.16***	***0.04***	***-3.66***	***0.0000***	***-0.24***	***-0.07***
CIEC	1.05	0.04	24.89	0.0000	0.97	1.13
ETIT	2.32	0.06	36.90	0.0000	2.20	2.44
FTSC	0.88	0.04	21.40	0.0000	0.80	0.97
NEIC	***-1.15***	***0.06***	***-19.38***	***0.0000***	***-1.27***	***-1.03***
NTLC	0.13	0.04	3.13	0.0020	0.05	0.21
ONTBF	0.88	0.05	17.22	0.0000	0.78	0.98
PALC	0.98	0.04	22.12	0.0000	0.89	1.06
PRSC	***-0.65***	***0.05***	***-13.54***	***0.0000***	***-0.75***	***-0.56***
SAFC	***-0.75***	***0.05***	***-15.21***	***0.0000***	***-0.85***	***-0.66***
SDCC	0.36	0.04	8.79	0.0000	0.28	0.44
SDSC	0.58	0.04	13.17	0.0000	0.49	0.67
SEMC	***-0.28***	***0.04***	***-6.27***	***0.0000***	***-0.36***	***-0.19***
SGBC	0.86	0.04	20.70	0.0000	0.78	0.94
SHEC	0.73	0.04	17.71	0.0000	0.65	0.81
SICC	***-1.01***	***0.06***	***-18.28***	***0.0000***	***-1.11***	***-0.90***
SIVC	0.63	0.04	15.16	0.0000	0.55	0.71
SLBC	***-0.17***	***0.04***	***-4.04***	***0.0000***	***-0.26***	***-0.09***
SMBC	0.12	0.04	2.79	0.0050	0.03	0.20
SNTS	2.46	0.06	40.05	0.0000	2.34	2.59
SOGC	1.06	0.04	25.01	0.0000	0.97	1.14
SPHC	1.61	0.05	32.68	0.0000	1.51	1.70
STAC	***-0.88***	***0.05***	***-17.03***	***0.0000***	***-0.98***	***-0.78***
STBC	0.73	0.04	17.72	0.0000	0.65	0.81
SVOC	***-0.49***	***0.05***	***-10.65***	***0.0000***	***-0.58***	***-0.40***
TTLC	0.36	0.04	8.84	0.0000	0.28	0.45
UNLC	0.48	0.04	11.76	0.0000	0.40	0.57
UNXC	***-0.42***	***0.05***	***-9.30***	***0.0000***	***-0.51***	***-0.33***
_cons	-0.60	0.03	-20.04	0.0000	-0.66	-0.55

Table 5: Estimated impact of the change on the daily trading volume

Instrumental (2SLS) regression

Number of obs	=	88.858
Wald chi2(70)	=	14466.73
Prob > chi2	=	0.0000
Root MSE	=	2.2849

Symbole	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
ABJC	0.99	0.13	7.35	0.0000	0.73	1.26
BICC	0.61	0.13	4.90	0.0000	0.37	0.86
BOAB	1.00	0.14	6.95	0.0000	0.72	1.28
BOABF	0.97	0.15	6.58	0.0000	0.68	1.26
BOAC	0.94	0.15	6.34	0.0000	0.65	1.23
BOAN	1.35	0.13	10.52	0.0000	1.10	1.60
CABC	0.79	0.13	6.19	0.0000	0.54	1.04
CFAC	*0.24*	*0.14*	*1.71*	*0.0880*	*-0.04*	*0.52*
CIEC	1.75	0.13	13.71	0.0000	1.50	2.00
ETIT	5.99	0.37	16.40	0.0000	5.27	6.70
FTSC	3.13	0.14	21.88	0.0000	2.85	3.42
NEIC	***-0.61***	***0.14***	***-4.21***	***0.0000***	***-0.89***	***-0.33***
NTLC	*2.37*	*1.63*	*1.45*	*0.1460*	*-0.83*	*5.56*
ONTBF	3.77	0.16	23.41	0.0000	3.45	4.09
PALC	4.61	0.27	17.08	0.0000	4.08	5.14
PRSC	0.43	0.17	2.59	0.0100	0.10	0.76
SAFC	*0.42*	*0.55*	*0.76*	*0.4440*	*-0.66*	*1.51*
SDCC	1.54	0.13	12.22	0.0000	1.30	1.79
SDSC	1.02	0.12	8.31	0.0000	0.78	1.26
SEMC	*0.68*	*1.26*	*0.54*	*0.5920*	*-1.80*	*3.15*
SGBC	2.50	0.14	18.16	0.0000	2.23	2.77
SHEC	1.07	0.13	8.04	0.0000	0.81	1.33
SICC	***-1.58***	***0.39***	***-4.03***	***0.0000***	***-2.35***	***-0.81***
SIVC	0.31	0.13	2.44	0.0150	0.06	0.56
SLBC	0.76	0.15	5.21	0.0000	0.47	1.04
SMBC	*-1.02*	*0.59*	*-1.73*	*0.0840*	*-2.19*	*0.14*
SNTS	1.56	0.15	10.65	0.0000	1.28	1.85
SOGC	20.61	1.58	13.06	0.0000	17.52	23.70
SPHC	***-14.03***	***0.69***	***-20.31***	***0.0000***	***-15.38***	***-12.67***
STAC	*-0.24*	*0.13*	*-1.87*	*0.0620*	*-0.49*	*0.01*
STBC	0.97	0.13	7.66	0.0000	0.72	1.22
SVOC	***-0.40***	***0.18***	***-2.17***	***0.0300***	***-0.76***	***-0.04***
TTLC	2.14	0.15	13.84	0.0000	1.83	2.44
UNLC	***-8.80***	***1.02***	***-8.62***	***0.0000***	***-10.81***	***-6.80***
UNXC	2.33	0.16	14.76	0.0000	2.02	2.64
_cons	-0.54	0.05	-10.36	0.0000	-0.65	-0.44

Table 6: Estimated impact of the quotation mode change on market impact

Two-step tobit with endogenous regressors

Number of obs	=	167.49
Wald chi2(145)	=	4795.4
Prob > chi2	=	0.0000

Symbole	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
ABJC	-0.01	0.01	-0.94	0.35	-0.02	0.01
BICC	0.01	0.01	0.98	0.33	-0.01	0.02
BNBC	0.02	0.01	1.61	0.11	0.00	0.04
BOAB	***0.02***	***0.01***	***2.39***	***0.02***	***0.00***	***0.04***
BOABF	0.00	0.01	0.19	0.85	-0.01	0.01
BOAC	0.01	0.01	1.09	0.28	-0.01	0.02
BOAN	-0.01	0.01	-1.31	0.19	-0.02	0.00
CABC	0.02	0.01	1.88	0.06	0.00	0.03
CFAC	-0.02	0.01	-1.62	0.11	-0.04	0.00
CIEC	0.00	0.01	0.13	0.90	-0.01	0.01
ETIT	0.00	0.01	-0.10	0.92	-0.02	0.02
FTSC	0.00	0.01	0.71	0.48	-0.01	0.02
NEIC	***-0.06***	***0.01***	***-6.07***	***0.00***	***-0.08***	***-0.04***
NTLC	-0.02	0.01	-2.02	0.04	-0.04	0.00
ONTBF	0.00	0.01	0.04	0.97	-0.02	0.02
PALC	0.00	0.01	-0.57	0.57	-0.02	0.01
PRSC	***0.04***	***0.01***	***2.99***	***0.00***	***0.02***	***0.07***
SAFC	***-0.09***	***0.02***	***-4.36***	***0.00***	***-0.12***	***-0.05***
SDCC	0.01	0.01	1.60	0.11	0.00	0.02
SDSC	***0.03***	***0.01***	***3.89***	***0.00***	***0.01***	***0.04***
SEMC	-0.02	0.01	-1.52	0.13	-0.04	0.01
SGBC	0.01	0.01	0.98	0.33	-0.01	0.02
SHEC	0.01	0.01	0.67	0.50	-0.01	0.02
SICC	***-0.05***	***0.01***	***-5.41***	***0.00***	***-0.07***	***-0.03***
SIVC	0.00	0.01	0.11	0.91	-0.02	0.02
SLBC	***0.03***	***0.01***	***3.76***	***0.00***	***0.02***	***0.05***
SMBC	***-0.03***	***0.01***	***-2.58***	***0.01***	***-0.05***	***-0.01***
SNTS	-0.01	0.01	-1.16	0.25	-0.03	0.01
SOGC	0.00	0.01	-0.09	0.93	-0.02	0.02
SPHC	-0.01	0.01	-1.19	0.24	-0.02	0.01
STAC	***-0.04***	***0.01***	***-3.56***	***0.00***	***-0.06***	***-0.02***
STBC	***0.02***	***0.01***	***2.73***	***0.01***	***0.01***	***0.04***
SVOC	***-0.07***	***0.01***	***-5.76***	***0.00***	***-0.09***	***-0.04***
TTLC	***0.03***	***0.01***	***4.14***	***0.00***	***0.01***	***0.04***
UNLC	***-0.02***	***0.01***	***-2.20***	***0.03***	***-0.04***	***0.00***
UNXC	***0.01***	***0.01***	***2.29***	***0.02***	***0.00***	***0.03***
Chang. on market impact	***-0.001***	***0.00***	***-0.36***	***0.72***	***0.00***	***0.00***
_cons	-0.31	0.01	-33.26	0.00	-0.33	-0.30