SUNSHINE TRADING IN WEST-AFRICA: LIQUIDITY AND PRICE FORMATION OF INFREQUENTLY TRADED STOCKS

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LIQUIDITY AND PRICE FORMATION OF INFREQUENTLY TRADED STOCKS

Abstract

This paper studies liquidity and price formation in the West-African Bourse. We provide evidence consistent with i) investors using the preopening period to implement sunshine trading, and ii) prices revealing information before trading actually occurs. We argue that market participants implement order placement strategies bound to enhance market liquidity. Along this line, this paper underlines the role of the preopening period as a powerful tool to disseminate information regarding both liquidity needs and stock valuation. We interpret our empirical results in the framework of a simple theoretical model. For some parameters' value, at equilibrium, market non-anonymity and repeated interaction enable investors to coordinate on trading strategies improving market quality as it is observed in the West-African Bourse. We provide some implications of our findings for global portfolio management and for the design of financial markets.

SUNSHINE TRADING IN WEST-AFRICA:
LIQUIDITY AND PRICE FORMATION IN AN EMERGING STOCK MARKET

1) Introduction

The empirical literature in market microstructure has underlined the role of preopening periods in the price discovery process. Biais, Hillion, and Spatt (1999) find that indicative prices in the Paris Bourse reflect learning of stocks' equilibrium valuation. Cao, Ghysels, and Hatheway (2000) highlight the same phenomenon during the Nasdaq preopening period. However, less attention has been focused on the potential influence of these pre-trade communication platforms on the formation of liquidity. This issue is of interest since, if preopening periods can generate useful pricing information, they could also allow market participants to pre-announce their willingness to trade. The present paper studies these questions in the context of an emerging market: the West-African Bourse[1].

Liquidity is an important aspect of financial markets' quality since it influences firms' access to capital and investors' return on investment. In a number of emerging markets, scholars have documented a poor liquidity (see for instance the comprehensive overview of stock market activity in Africa by Kenny and Moss, 1998). The importance of the liquidity formation process is thus likely to be magnified in emerging stock markets. Understanding liquidity formation and the role of preopening periods may generate useful guidance for the design of financial markets.

Our empirical investigation is based on the liquidity formation model proposed by Admati and Pfleiderer (1991). They show that, if market participation is costly for liquidity providers, then investors may find advantageous to preannounce their liquidity needs. Such preannouncements enable better coordination between the demand and the supply of liquidity. They refer to the practice of preannouncing liquidity needs as sunshine trading. The West-African Bourse is an ideal place to look for sunshine trading. On the one hand, the Bourse is not included in the international stock market indexes. As long as money managers' performance evaluation and compensation being tied up to these international indexes, they may have to incur a cost of market participation to be active on the Bourse. This cost of market participation can be viewed as the opportunity cost of time spent gathering information about the West-African economic prospects. On the other hand, the Bourse is organized as a preopening period followed by a call auction. The preopening

[1] The West-African Bourse is called in French the *Bourse Régionale des Valeurs Mobilières* (BRVM).

period can thus constitute "the formal mechanism for preannouncements to reach all traders" (Admati and Pfleiderer, 1991, footnote 1, page 444).

Our empirical results can be summarized as follows. Large orders are submitted and large quantities proposed long before the end of the preopening period. These orders and quantities are seldom revised or cancelled, and often end up executed. Our interpretation of these findings is that, in the spirit of sunshine trading, early order placement allows broker-dealers to inform outside investor of the outstanding liquidity needs. We identify the fact that a significant portion of the orders placed early is eventually executed as evidence of liquidity providers' response to sunshine trading. We also focus on price formation during the preopening period[2]. We find that early indicative prices are related to the call transaction price, indicating that these non-binding quotes play an important role in the price formation process. We also find evidence that private information (if any) is partly reflected in early indicative prices, i.e. indicative prices computed and announced on average between 120 and 50 minutes before the call auction. This result complements the findings of Biais, Hillion, and Spatt (1999) showing that, in the Paris Bourse, indicative prices are revealing towards the end of the preopening period.

We propose a simple dynamic model to show how liquidity and price formation patterns are intertwined and how the patterns found on the West-African Bourse can emerge as part of a financial market equilibrium with costly participation. This model suggests that market non-anonymity and repeated interaction are crucial for sunshine trading and information revelation to emerge. In the spirit of Admati and Pfleiderer (1991), at equilibrium, traders preannounce their liquidity needs during the preopening period. Relying on such preannouncement, liquidity providers incur the cost of market participation and act as a counterpart. Unlike in Admati and Pfleiderer (1991), in our model, investors engaging in sunshine trading may have superior information concerning stock valuation. We show that there exist some parameters for which, at equilibrium, investors voluntarily choose to reveal this information during the preopening period. Agents deviating from preannounced trading intentions or profiting from private information are susceptible to be identified and punished. This is in the spirit of Benveniste, Marcus, and Wilhelm (1992). In our model, punishment is explicitly modeled and takes the form of future refusals to provide liquidity to the deviating traders. The cost associated with future liquidity denials can be rather damaging for highly risk-averse traders or for risk-averse traders subject to important liquidity shocks.

This paper has implications for global portfolio management and for the design of financial markets. It suggests that the liquidity on the West African Bourse is higher than what is indicated by the order book. Indeed the practice of sunshine trading appears to enable

[2] This issue is not studied in Admati and Pfleiderer (1991) since preannouncing traders cannot specify limit prices.

traders with high liquidity needs to attract liquidity providers. There is a latent liquidity that is not reflected in the order book because of the market participation cost, and that is realized only when traders engage in sunshine trading. This implies that transaction costs on the Bourse are overestimated when measured by the depth of the order book (see for example the measure developed by Kehr, Krahnen, and Theissen, 2001[3]). This indicates that money mangers willing to trade on the Bourse might make better deals than what is suggested by the average trading activity. This paper also shows that the preopening period may play an important role in disseminating information to market participants concerning liquidity needs. This information is useful to coordinate the demand and the supply of liquidity. Liquidity providers only enter the market when there is a preannouncement. Traders thus save on the cost of market participation. In emerging markets where the cost of market participation is high and where the probability of a liquidity shock is low, this saving can considerably improve traders' welfare. Market organizers may thus have an interest in providing traders with pre-trading communication platforms such as preopening periods as a mean to disseminate information regarding both liquidity needs and asset valuation. For the preannouncement to be credible, market participants should be able to identify and punish untruthful traders. Market non-anonymity is thus also required and may act as "a technology for the enforcement of commitments made through preannouncements" (Admati and Pfleiderer, 1991, footnote 1, page 444).

This paper is related to the literature on liquidity and price formation. Biais, Hillion, and Spatt (1995) study the formation process of the order book in the Paris Bourse. Lehmann and Modest (1994) investigate liquidity provision in the Tokyo Stock Exchange. De Jong, Nijman, and Roell (1995), Chan and Lakonishok (1997) and Kehr, Krahnen, and Theissen (2001) focus on the measurement of transaction costs in various market mechanisms. Biais, Hillion, and Spatt (1999), and Cao, Ghysels, and Hatheway (2000) study price formation during preopening periods in stock exchanges. The impact of communication through non-binding quotes on price discovery has also been investigated by Aggarwal and Conroy (2000) for initial public offerings, and by Peiers (1997) for foreign exchange markets. Price discovery during trading periods has been the focus of numerous studies including Stoll and Whaley (1990), Amihud and Mendelson (1991), and Madhavan and Panchapagesan (2000). Our work complements these papers by shedding light on the liquidity formation process, and by underlining the close relationship between liquidity and price formation.

Following Bhattacharya and Spiegel (1991), and Spiegel and Subrahmanyam (1992), our theoretical model incorporates two trading motives: informed speculation and hedging. Our study is related to the work of Vives (1995), and Medrano and Vives (2001). By offering an

[3] Their measure has been designed for and applied to the Frankfurt Stock Exchange. In this case, since market participation costs are arguably low, the bias we are referring to is unlikely to prevail.

integrated framework to analyze liquidity and price formation simultaneously, we show that traders can voluntarily reveal their private information even when they are sure they can revise or cancel their orders[4]. This result echoes the findings of Spatt and Srivastava (1991) that truthful preplay communication in initial public offerings can be part of an optimal auction mechanism. However, in their model, traders' incentives to disclose private information are different: at equilibrium, announcing true valuations does not affect prices but it maximizes traders' probability to receive the asset (in the spirit of a second price auction). Our modeling approach is also related to Desgranges and Foucault (2002). They study the emergence of reputation-based pricing in a dealer market by explicitly modeling the long-term relationship between traders and brokers. They show that agents may strategically refrain from trading on information when dealing with their regular market-maker in order to profit from price improvements.

African emerging stock markets are not the only marketplaces that suffer from a lack of liquidity. As Easley, Kiefer, O'Hara, and Paperman (1996) emphasize, many stocks listed on established markets such as the New York Stock Exchange or the Nasdaq trade infrequently. The insights provided by the present paper may thus have implications for trading in developed markets.

The rest of this paper is organized as follows. Section 2 describes the market organization and the data set. Sunshine trading and information revelation during the preopening period are documented in Section 3 and 4 respectively. The theoretical model is developed in Section 5. Section 6 concludes.

2) Description of the Market and the Dataset

2.1) Structure of the West-African Bourse

Based in Abidjan, the West-African Bourse (or Bourse Régionale des Valeurs Mobilières) has been launched in September 1998. It has been created after the Ivory Coast Bourse. It can accommodate listing of companies originating from the various countries of the West-African Economic and Monetary Union (Union Economique et Monétaire Ouest-Africaine). In 2000, 40 stocks were traded on the market. 39 were from Ivory Coast and 1 from Senegal.

The West-African Bourse is an electronic order market. Orders can be placed by sixteen broker-dealers via computers located at the Bourse offices or at the brokerage houses themselves. Only these sixteen agents can place orders[5]. The West-African Bourse operates

[4] See also Brusco, Manzano, and Tapia (1998)

[5] In 2002, a new broker-dealer has been authorized by the Bourse.

three times a week on Monday, Wednesday and Friday[6]. It is organized as a preopening period followed by a call market. During the preopening period, from 8:30 am to 10:30 am, broker-dealers can place limit orders that can be freely cancelled or revised[7]. Each time an order is entered in the system, an indicative market clearing price is computed and announced to the broker-dealers. Furthermore, these broker-dealers can observe the entire order book, i.e. the characteristics of the orders, the identity of the broker-dealer who placed the orders, and whether or not they trade for their own account. At 10:30, the orders present in the book are confronted to build the aggregate supply and demand curves. The transaction price is the price that maximizes trading volume[8]. Buying (selling) orders with a limit price greater (smaller) than or equal to the market clearing price are executed. Rationing occurs when there is an order imbalance at the market clearing price. Orders are executed proportionally to their proposed quantity. There is no time priority. If supply and demand do not cross, another trading session is organized which is similar to the previous one. A preopening period occurs from 11:00 to 11:30 (the orders present in the book at 10:30 are still valid for this new session). The orders are potentially filled at 11:30.

2.2) Data Set

Our data set includes all the orders submitted to the market from January 3rd, 2000 to December 13th, 2000. This corresponds to 141 trading sessions. We have all the characteristics of the orders including their time of placement, their limit price, the quantity proposed, and the identity of the broker-dealers who placed the orders. However, we do not know whether an order is placed for a client or for the broker-dealer's own account. For each session, we computed the indicative prices, and the market clearing price.

Among the 40 stocks listed on the Bourse, we selected the stocks that were included in the index of the Bourse. The index is composed of 10 stocks. Among these 10 stocks, only three remained in the index throughout the year 2000. We complemented our data set by choosing five additional stocks that remained in the index at least 2 quarters during the year 2000.

Remind that the second section uses the Morgan Stanley Capital International indexes provided by Datastream. The data set includes the daily returns for various national markets over the first five months of the year 2000. During this period, the West African Bourse operated daily. Note that for the West African Bourse only capital gains are considered.

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[6] Since the end of 2001, the Bourse is open daily.

[7] Market orders have been prohibited after a few months of operations.

[8] If there are several volume maximizing prices, other criteria are applied until only one price remains. These criteria consist in choosing the price that i) minimizes excess demand, and ii) minimizes variation between successive prices. If several prices still satisfy these constraints, the transaction price is the highest of these prices.

2.3) Summary Statistics

Market Activity - For each stock, Table 1 reports several descriptive statistics for the year 2000 including the average and standard deviation of the volume per trading session, the average number of orders per trading sessions, and the turnover defined as the total number of shares traded over the number of outstanding shares.

The volume per trading session, and the number of orders submitted to the market are on average quite low. These phenomena are reflected in a very low turnover. The market thus appears rather inactive. This is confirmed by the large number of trading sessions without trades.

Interestingly, despite the apparent low liquidity, the transaction volume is quite volatile. This suggests that, from time to time, the market experiences shocks on the demand and/or on the supply of shares. This time series pattern in transaction volume is also found in other emerging markets such as Morocco. In the Casablanca Stock Exchange, some stocks are traded via a daily call market. Data provided by the Exchange on its website suggest the same pattern in transaction volume as the one documented in West-Africa. This high trading volume volatility despite the low average volume suggests that the West-African Bourse is punctually able to accommodate large transactions.

The extent of orders cancellations and modifications appears limited: overall, only 2% of the orders are cancelled, and only 7% are modified.

Broker-dealers' Activity - Table 1 indicates that the number of broker-dealers active on the market is low. Between two and seven broker-dealers (out of sixteen) intervene on the market. This means that all the broker-dealers are not providing liquidity at every trading session. Following Ellis, Michaely, and O'Hara (2000), to assess the competitiveness of the Bourse, we computed for each stock the average Herfindahl index across the sessions with a non-null trading volume. For a given trading session, the index is equal to the sum of the squares of the market share of each broker-dealer. The market share of a broker-dealer is computed as the ratio of the number of shares traded by the broker-dealer over the transaction volume. An index of one corresponds to a monopolistic market while an index of 1/n, n being the number of active broker-dealers, corresponds to a perfectly competitive market with every broker-dealer trading the same volume. Table 1 shows that the Bourse is an oligopoly market, neither perfectly competitive nor in a monopoly situation. This result echoes the findings of Ellis, Michaely, and O'Hara (2000) who draw similar conclusions for the NASDAQ market, and in particularly for low volume stocks. Table 2 complements these results. It presents the broker-dealers' activity in terms of order placement and shares traded averaged across stocks and trading sessions. Table 2 shows that 8 broker-dealers account for 99% of the transaction volume and that the 4 largest broker-dealers alone account for 89% of this volume. The Bourse thus appears as a concentrated trading venue where a few agents are making the market.

Transaction Costs - Table 3 presents a measure of transaction costs for the various stocks under study. This measure was constructed following Kehr, Krahnen, and Theissen (1998). For each trading session, we added one buying market order in the order book, and computed the new transaction price (P_b). After canceling this buying order, we added one selling market order, and computed another transaction price (P_s). Transaction costs were measured by the following formula: $\frac{P_b - P_s}{P^*}$ where P^* was the actual transaction price. We computed this measure by adding orders of various sizes: one, ten, a hundred, two hundred, five hundred, and one thousand. For each stock, we computed the average transaction cost across trading sessions where the additional buy or sell orders could find a counterpart. The number of trading sessions in which the order book was not thick enough to allow execution of the additional orders is also provided. These trading sessions may be viewed as infinitely illiquid.

Table 3 suggests that transaction costs are huge on the West African Bourse. They represent from 2.6% to 16.4% of the transaction price for a one hundred-share order with an average equal to 6.8% for the 8 stocks we consider. Compared to the findings of Kehr, Krahnen, and Theissen (1998) concerning the opening call in Frankfurt, these transaction cost appear rather large. Moreover, there is a lot of trading sessions, from 26 up to 130 sessions, in which it was not even possible to add one-share orders and still find counterparts. This is again a sign of extremely poor liquidity on the Bourse. Such a low liquidity is in some sense at odd with the fact that high volumes are observed on particular days. In fact, we shall see that this measure consistently overestimates transaction cost since it only considers submitted orders and not latent orders. In the context of an emerging market, the bias can be important because of the cost associated with market participation.

3) Sunshine Trading

This section studies the liquidity formation process in the West-African Bourse. The summary statistics presented above suggest that the trading activity is on average quite low and volatile. The returns volatility is also low. To complement these points, Figure 1 shows the number of shares traded on the market along with the transaction price over the 141 trading days in our sample. Panels A trough H correspond to the 8 stocks under study sorted alphabetically. For all the stocks, the trading volume appears highly volatile while the prices are surprisingly stable. These features indicate that the market is punctually able to accommodate huge transactions without major price adjustments.

Building on these graphical impressions, we performed the following regressions. For each stock, we regressed the absolute returns from the last trading sessions (a measure of the price volatility) onto the contemporaneous trading volume. The estimated equation was:

$$\frac{\left|P_t - P_{t-1}\right|}{P_{t-1}} = a + b \times Q_t + e_t$$

t represents the time expressed in terms of trading sessions with a non-null trading volume. *P.* is the transaction price in CFA francs, and *Q.* is the trading volume in shares. The results are in Table 4.

For the 8 stocks, the coefficient *b* appears non significantly different from zero. Further, the regression R^2s are extremely low. For the 8 stocks, we can reject the hypothesis that trading volume has an impact on prices, and in particular that high volumes translate into prices destabilization. This may appear counterintuitive as one would expect a thin market to generate high execution costs. This phenomenon is at the core of our empirical investigation, and motivated our subsequent analyses.

We interpret these results in terms of sunshine trading. Admati and Pfleiderer (1991) developed a model whereby liquidity providers have to incur a cost for intervening on the market. When this cost is high, it produces a thin market with high execution costs since liquidity providers are reluctant to enter the market. To overcome this difficulty, an investor with liquidity needs may find advantageous to announce before trading occurs the extent of her willingness to trade. In light of this announcement, liquidity providers may decide to bear the cost of entrance and to participate to the transactions. Admati and Pfleiderer (1991) show that, at equilibrium, this sunshine trading enhances liquidity and therefore reduces the execution costs. This model is relevant in the context of the West-African Bourse.

On the one hand, the Bourse is not included in global indexes such as the MSCI World Index or the IFC Global Emerging Markets Index. This indicates that portfolio managers may have incentives to direct resources (time and research effort) towards other stock markets than the West-African Bourse. It implies that, for global portfolio managers, there is an implicit cost of participation to the West-African Bourse. On the other hand, the domestic saving rates that are very low in the region may hardly constitute an alternative to improve liquidity (see Kenny and Moss, 1998). Altogether, this suggests that the Bourse is poorly monitored by potential liquidity providers thereby explaining the low average volume. However, the fact that the market appears able to absorb large transactions without major price movements is the sign that the liquidity of the Bourse is not as low as one may judge based on averaged data. In particular, if large liquidity needs are preannounced during the preopening period, broker-dealers have time to communicate them to potential outside investors. This process may trigger a flow of liquidity towards the market that would not exist without preannouncement.

Applied to the West-African Bourse, the model of Admati and Pfleiderer (1991) has several empirical implications. First, to preannounce their liquidity needs, investors should place orders early during the preopening period. In particular, to the extent that large liquidity needs primarily require preannouncement, large orders should be observed early during the preopening. Then, in order to constitute credible announces, these orders should not be cancelled before the call. Finally, if sunshine trading is successful on the Bourse, a significant part of the orders placed early should be eventually executed.

Tables 5 and 6 speak to these issues[9]. To construct these tables, we classified the orders according to two dimensions: their size and their time of placement during the preopening period. Each dimension was divided in four quartiles. This created a 16-cell table. The upper-left cell includes the orders pertaining to the fourth quartile in terms of size, and to the first quartile in terms of placement time. This cell thus includes the large orders that are placed early during the preopening period. Table 5 presents the average proportion of orders of various sizes placed during the four intervals of the preopening period[10]. The first quartile of placement time is on average 9:16 am. The second quartile of placement time is on average 9:39 am. The third quartile of placement time is on average 10:07 am. The first quartile of order size is on average 9 shares. The second quartile of order size is on average 32 shares. The third quartile of order size is on average 92 shares.

Since sunshine trading is more likely to occur when large quantities have to be traded, our analysis will focus on large orders, i.e. orders pertaining to the 4th and 3rd size quartiles.

From Table 5, we can compute the proportion of large orders placed in the first part of the preopening period (before the median placement time). These proportions are 50% and 56% for the 4th and 3rd size quartiles respectively. This means that large orders are quite often placed early during the preopening period.

To verify that such large orders do not only reflect market manipulation, Table 6 reports the proportion of orders executed in each category. It indicates for each order size and each placement time the proportion of orders that have been (partially) filled at the time of the call.

[9] We have not analyzed order cancellations and modifications since only a fairly small fraction (overall 9%) of the orders is affected by such operations (see the summary statistics).

[10] Columns and rows do not always add up to 25% of the total number of orders. This happens when several observations fall on the limit between two quartiles. In this case, they were classified in the lower quartile.

From Table 6, we see that 28% of the large orders placed early (4th and 3rd size quartiles, and 1st and 2nd time quartiles) are on average executed. This indicates that a substantial part of these orders is in the market.

Figure 2 illustrates these findings. It shows that large orders are uniformly distributed over time and that part of the orders placed in the first part of the preopening period end up executed.

These results may appear surprising if one believes that traders have incentives to refrain from placing orders as long as executions are not allowed. Indeed, insiders may be willing to conceal their information as long as possible. Uninformed traders may be willing to wait to gather as much information as possible. However, as shown by Admati and Pfleiderer (1991), traders may have an interest to preannounce their liquidity needs in order to attract potential liquidity providers.

Our result that a significant order placement activity develops during the preopening period when no transaction occurs complements the empirical findings of Biais, Hillion and Spatt (1999) concerning the Paris Bourse. Note that, in the West-African Bourse, an intense activity occurs well before the time of the call. On average, the median placement time is 9:39 am meaning that half of the orders are already placed more than 50 minutes before transactions occur. In contrast, the major part of the order placement in the Paris Bourse occurs during the last 30 minutes of the preopening period.

To give an idea of the economic significance of the large orders we focus on, Table 7 provides the proportion of shares corresponding to each category, averaged across the 8 stocks; Table 8 presents the proportion of shares that are eventually exchanged[11].

It appears that the large orders (4th and 3rd size quartiles) represent 97% of the quantities that are proposed on the market. These orders are thus of high economic importance. From Table 7, we obtain that 38% and 57% (for the 4th and 3rd size quartiles respectively) of the total quantity proposed via large orders are offered in the first part of the preopening period (before the median placement time). Furthermore, Table 8 indicates that on average 28% of the quantity proposed via large orders placed early (4th and 3rd size quartiles, and 1st and 2nd time quartiles) is eventually exchanged at the time of the call.

These results confirm the previous results obtained with orders. They indicate that when broker-dealers want to exchange large quantities of shares, they place large orders early during the preopening period, orders that are often executed during the call. At the beginning of this section, we showed that large traded quantities do not incur high execution costs. Our interpretation is that broker-dealers engage in sunshine trading to attract potential liquidity providers. The very low average trading volume in the West-African Bourse suggests that, without sunshine trading, it would be very difficult to trade large quantities of shares.

Admati and Pfleiderer (1991) note that, for the sunshine trading to be effective, the preannouncement should be credible in the sense that agents engaging in sunshine trading should really trade the quantities they preannounced. The fairly low number of order cancellations or modifications indicates that offers made during the preopening period can indeed be considered as firm. Section 6 proposes a model showing that perfect pre- and post- trade transparency along with repeated interaction among market participants may trigger a tacit agreement among broker-dealers to punish deviating agents. In the model, punishment of broker-dealers takes the form of future denial to respond to sunshine trading. Given the huge quantities involved in such operations, this may constitute a quite damageable perspective for broker-dealers with a high volume of affair.

4) Price Discovery and Information Revelation

This section studies the price formation process in the West-African Bourse. When they place orders, broker-dealers have to post limit prices. Over the course of the preopening period, these orders are crossed and their limit prices translate into indicative prices. These indicative prices are publicly available. If traders engage in sunshine trading, we should observe that indicative prices during the preopening period are somehow linked to call prices. It is clear that toward the end of the preopening period, prices converge toward the call price: the call price per construction equals the last indicative price. However, under the hypothesis of sunshine trading, one expects that indicative prices computed early during the preopening period are related to the actual call price. Admati and Pfleiderer (1991) state that agents have to trade the quantities they preannounced. Extending this argument, when implementing sunshine trading, agents should choose to preannounce prices at which they stand ready to trade. This would lead to a link between the early tentative prices and the transaction price.

To study this issue, we computed the average indicative price before and after the median placement time. We then regressed the return from the previous trading session to the call price onto the return from the previous trading session to the indicative prices. For each of the 8 stocks, the estimated equation was:

$$\frac{P_t - P_{t-1}}{P_{t-1}} = A^1 + B^1 \times \frac{IP_t^1 - P_{t-1}}{P_{t-1}} + E_t^1$$

[11] We did not take rationing into account.

t represents the time expressed in terms of trading sessions with a non-null trading volume. *P.* is the transaction price in CFA francs. IP^1 is the average indicative price during the first part of the preopening period. The results are in Table 9.

Indicative prices computed and announced during the first part of the preopening period are indeed related to the call price for 7 out of 8 stocks. This means that, by looking at early indicative prices, broker-dealers can have a pretty good idea of the price that will prevail on the market.

Given that no transactions occur during the preopening period, the informational content of indicative prices can be questioned. In the context of sunshine trading, this issue becomes crucial since preannouncers are big participants and may try to manipulate market prices. Following the discussion in Biais, Hillion, and Spatt (1999), we posit two competing hypotheses regarding the informational efficiency of preopening prices. On the one hand, during the preopening period, orders can be freely canceled or modified. Traders could thus manipulate the market by using order placement strategies intentionally at odds with their expectations concerning the equilibrium value of the securities. As there is no time priority, traders could also delay their intervention on the market in order to conceal their trading strategies and reduce their impact on the market. According to these arguments, indicative prices should not reflect any information. On the other hand, when there is a risk of communication breakdown that would prevent the agents from placing all their desired orders, they may place orders that reflect their information even in the absence of immediate execution. This is in line with the theoretical analysis of Vives (1995), and Medrano and Vives (1998). As documented early, few broker-dealers are active on the market. Given the high degree of market transparency, traders could rapidly be identified if they were profiting from insider information at the expense of the other market participants. In the spirit of Benveniste, Marcus, and Wilhem (1992), broker-dealers may have incentives to reveal their information in order to profit from good execution conditions, and to avoid future punishments. According to these arguments, indicative prices should display strong informational efficiency.

To test these hypotheses, we study whether the return between the previous trading session and the next trading session can be predicted by the return between the previous trading session and the preopening period. For each stock, we used OLS regressions to estimate the following equation:

$$\frac{P_{t+1} - P_{t-1}}{P_{t-1}} = \alpha^1 + \beta^1 \times \frac{IP_t^1 - P_{t-1}}{P_{t-1}} + \varepsilon_t^1$$

t represents the time expressed in terms of trading sessions with a non-null trading volume. *P.* is the transaction price in CFA francs. IP^1 is the average indicative price during the first part of the preopening period. To have a measure of the total information that could have been revealed during the preopening period, we also ran these regressions with the call price P_t instead of the average indicative price IP_t. The estimated equation was:

$$\frac{P_{t+1} - P_{t-1}}{P_{t-1}} = \alpha + \beta \times \frac{P_t - P_{t-1}}{P_{t-1}} + \varepsilon_t$$

The results are in Tables 10 and 11.

Table 10 indicates that, for some stocks, early indicative prices incorporate information. This can be seen as the coefficient β is statistically significant 5 times out of 8 at the 10% error level (4 times out of 8 at the 5% error level). Pooling data from Tables 10 and 11, the amount of information revealed by the first part of the preopening period can be measure by the ratio between the R^2 of the regression using the average indicative price during the first part of the preopening period and the R^2 of the regression using the call price. Across the 8 stock, 44% of the information is on average revealed during the first part of the preopening period. Information revelation is also reflected in the fact that $beta^1$ is in general significantly greater than zero. However indicative prices during the preopening period do not reflect all the information that is incorporated in the call price. This can be seen from the fact that $beta^1$ is overall smaller than 1, or from the fact that the R^2 in Table 10 are in general smaller than the R^2 in Table 11. This could leave room to insiders' profit. In the context of sunshine trading, the agents cannot afford to profit from insiders' profits without suffering from future denial of liquidity provision. Large broker-dealers who implement sunshine trading are thus less likely to be identified as insiders.

To tackle this issue, we looked at whether broker-dealers' positions could predict the future evolution of securities' prices. For each stock and each broker-dealer, we regressed the future returns (from the current trading session to the next) onto the signed quantity traded by the broker-dealer. The estimated equations were:

$$\frac{P_{t+1} - P_t}{P_t} = x + y \times q_t + z_t$$

t represents the time expressed in terms of trading sessions with a non-null trading volume. *P.* is the transaction price in CFA francs. *q.* is the signed quantity (positive for a purchase, and negative for a sale) traded by the broker-dealer. A broker-dealer is identified as insider as soon as the regression coefficient is positive and statistically significant at the 10% error level. Table 12 reports the number of times each broker-dealer has been identified as insider across the 8 stocks in our sample.

Overall, very few broker-dealers have been identified as insiders. This indicates that the adverse selection risk on the market is fairly low. This may appear surprising in an emerging market but can be explained by the fact that information is revealed during the preopening period. Furthermore, the broker-dealers identified as insiders are not the major broker-dealers of the marketplace (see summary statistics). This finding reinforces the conclusions of the previous section. These major broker-dealers are indeed the ones susceptible to engage in sunshine trading, and are thus the ones who may suffer from future liquidity denials. If they engage in sunshine trading, it seems reasonable to think that they do not attempt to mislead their trading partners. On the other hand, the small broker-dealers that do not receive liquidity shocks because they do not deal much with outside investors can afford to profit from private information if they have some. The following section proposes a model where voluntarily information revelation arises in a financial market equilibrium.

5) Theoretical Model

This section develops a simple model of trading inspired by Admati and Pfleiderer (1991). The objective is to show that the liquidity and price formation patterns observed on the West-African Bourse can be sustained as part of an equilibrium with non-anonymity and repeated interaction. The model also stresses the important role of the pre-opening period in disseminating information to market participation, information regarding both stock valuation and liquidity needs.

Consider a market for an asset whose value V is 1 or -1 with equal probability ½. There are two investors: one outside investor (referred to as O) and one inside investor (referred to as I). Each investor accesses the Bourse thanks to the intermediation of a broker. We do not model the relationship between investors and brokers in a principal-agent framework but rather assume that their interests are perfectly aligned. Consequently, we do not explicitly model broker's behavior[12].

The outside investor is risk neutral. She participates to the market only if she pays a cost c. Her utility function is $U^O(w)=w$. She has no private information and her reservation utility is zero. In line with the theoretical work of Bhattacharya and Spiegel (1991) and Spiegel and Subrahmanyam (1992), the insider has two trading motivations: hedging and informed speculation. The inside investor is risk averse. His utility function is $U^I(w)=w$ if $w<0$, and

[12] As will be shown below, the only role of brokers in our model, besides transmitting investors' orders to the market, is to communicate the occurrence of sunshine trading to outside investors.

$U^I(w)=0$ otherwise. He (or his broker-dealer) receives a private signal s that indicates the actual value of the asset with probability p, with ½<p<1. When the value is 1, the signal indicates H with probability p, and L with probability 1-p. When the value is -1, the signal indicates L with probability p, and H with probability 1-p. The inside investor also receives an endowment shock noted q. With probability $\lambda/2$, he receives +Q units of asset, and with probability $\lambda/2$, he receives -Q units of asset. Insider's participation to the market is free.

The preferences of the agents have been extremely simplified. However, the only feature that is needed for our results to hold is the existence of gains from trade. In other words, the important ingredient is the heterogeneity of preferences that authorizes risk sharing among market participants.

After trading occurred, the value of the asset is realized and consumption takes place. At this time, as in Benveniste, Marcus, and Wilhelm (1992), there is a probability γ that the outsider learns the information held by the insider[13].

Transactions occur in a call market: the insider and the outsider simultaneously submit limit orders. In the cases where the orders of the insider and of the outsider cross, we will consider that the market price is the limit price set by the insider. This is equivalent to assuming that the insider can place stop orders in addition to limit orders. Given that there are gains from trade, the equilibrium price determines how the surplus is allocated among agents. This assumption is not crucial but rather plays the role of an equilibrium selection device. It implies that, at the equilibrium we consider, the insider obtains the entire surplus. The intuition behind our results would still hold even if the allocation of the surplus was different than the one we have chosen.

Two distinct market organizations will be analyzed. We will first consider a single call market. We will then study a situation where there are two successive call markets with no transactions occurring in the first market. This first call market will be referred to as the preopening period. We assume that all the traders can observe the entire order book. Trading takes place only at the second call market. A trader participating in the first call can revise or cancel his or her orders for the second call.

5.1) One trading period

In this subsection, we prove that, if there is only one trading period, there exists no equilibrium where the outsider provides liquidity and the insider sets revealing prices. This

[13] Alternatively, this probability can be interpreted as the result of a statistical inference to detect whether traders are profiting from superior information. A explicit modeling of this detection effort is found in Desgranges and Foucault (2002).

result holds whether the market is organized as a single call or as a preopening period followed by a call.

Single Call Market - Consider first the case where the market is organized as a single call. Consider the following revealing equilibrium conjecture. In the intention of transmitting the risk to the risk-neutral outsider while revealing his information, the insider submits a limit order to exchange –q. He sets a limit price so that the outsider anticipating revealing prices just break even. This limit price is thus equal to the expected value of the asset given insider's information adjusted for the cost of market participation. When the insider is selling, the limit price is 2p-1-c/λQ when s=H, and 1-2p-c/λQ when s=L. When the insider is buying, the limit price is 2p-1+c/λQ when s=H, and 1-2p+c/λQ when s=L[14]. For analytical simplicity, we assume that 2p-1>c/λQ (assumption A). The outsider anticipates that the insider is setting revealing prices and that he leave her a discount to compensate for the times at which she enters the market and no transaction occur. The best she can do to provide liquidity to the market is to submit the following limit orders: buy Q shares with a limit price equal to 2p-1-c/λQ and sell Q shares with a limit price equal to 1-2p+c/λQ[15].

Because the insider sets fully revealing prices and leaves the appropriate profit to the outsider, her expected utility is null:

$$E\left[U^O\left(W^O\right)\right]=0$$

The unconditional expected utility of the insider is given by:

$$\begin{aligned}E\left[U^I\left(W^I\right)\right]=&\frac{1}{2}p\frac{\lambda}{2}U^I\left[Q\left(2p-1-\frac{c}{\lambda Q}\right)\right]+\frac{1}{2}p\frac{\lambda}{2}U^I\left[-Q\left(2p-1+\frac{c}{\lambda Q}\right)\right]+\frac{1}{2}p(1-\lambda)U^I[0]+\\&\frac{1}{2}(1-p)\frac{\lambda}{2}U^I\left[Q\left(1-2p-\frac{c}{\lambda Q}\right)\right]+\frac{1}{2}(1-p)\frac{\lambda}{2}U^I\left[-Q\left(1-2p+\frac{c}{\lambda Q}\right)\right]+\frac{1}{2}(1-p)(1-\lambda)U^I[0]+\\&\frac{1}{2}(1-p)\frac{\lambda}{2}U^I\left[Q\left(2p-1-\frac{c}{\lambda Q}\right)\right]+\frac{1}{2}(1-p)\frac{\lambda}{2}U^I\left[-Q\left(2p-1+\frac{c}{\lambda Q}\right)\right]+\frac{1}{2}(1-p)(1-\lambda)U^I[0]+\\&\frac{1}{2}p\frac{\lambda}{2}U^I\left[Q\left(1-2p-\frac{c}{\lambda Q}\right)\right]+\frac{1}{2}p\frac{\lambda}{2}U^I\left[-Q\left(1-2p+\frac{c}{\lambda Q}\right)\right]+\frac{1}{2}p(1-\lambda)U^I[0]\end{aligned}$$

$$\begin{aligned}E\left[U^I\left(W^I\right)\right]=&-\frac{1}{2}p\frac{\lambda}{2}Q\left(2p-1+\frac{c}{\lambda Q}\right)+\frac{1}{2}(1-p)\frac{\lambda}{2}Q\left(1-2p-\frac{c}{\lambda Q}\right)\\&-\frac{1}{2}(1-p)\frac{\lambda}{2}Q\left(2p-1+\frac{c}{\lambda Q}\right)+\frac{1}{2}p\frac{\lambda}{2}Q\left(1-2p-\frac{c}{\lambda Q}\right)\end{aligned}$$

[14] The premium and the discount are set such that the outsider just breaks even.
[15] In order for her orders not to cross, the outsider has to submit the buying and the selling order through two different brokers.

$$E\left[U^I(W^I)\right] = -\frac{\lambda}{2}Q(2p-1) - \frac{c}{2}$$

If there is no trade, the unconditional expected utility of the insider is:

$$E\left[U^I(W^I)\right] = -\frac{\lambda}{2}Q$$

The individual rationality constraint of the outsider is always satisfied since her expected utility equals her reservation utility. The individual rationality constraint of the insider is satisfied if $c<2\lambda Q(1-p)$. This inequality reflects a tradeoff between the risk sharing benefits the insider obtains through trading, and the utility he has to forego to compensate the outsider for providing liquidity. If the participation cost of the outsider is too high compared to the probability of receiving an endowment shock or compared to the importance of this shock, then the insider is better off not trading and bearing all the risk. Remark that since the insider is the price setter, he reaps all the gains from trade.

However, this situation is not an equilibrium since there exist profitable deviations for the insider. In particular, when he receives a good signal and a negative endowment shock, the insider will deviate and choose to set the price as if he had received a bad signal in order to decrease his buying price. The insider will also deviate when he receives a bad signal and a positive endowment shock. He will choose to set the price as if he had received a good signal in order to increase his selling price. The expected utility that the outsider gets if he deviates is:

$$E\left[U^I(W^I)\right] = 0$$

Insider's expected utility when deviating is greater than the one he obtains when following the strategy stated in the equilibrium conjecture. Consequently, this conjecture is not an equilibrium.

Preopening Period and Call Market - Consider now the case where the market is organized as a call market preceded by a preopening period.

Consider the following revealing equilibrium conjecture. To achieve better coordination with the liquidity provider, the insider participates to the preopening period by submitting a limit order to exchange –q. He sets a limit price so that the outsider anticipating revealing prices just break even. Brokers contact the outsider, and report the preannounced liquidity need. The outsider thus observes the insider's order, and believes that it truthfully reflects insider's liquidity needs and information. During the call market, the insider submits the same order as during the preopening period, and the outsider submits a limit order to exchange q. Her limit price is 2p-1-c/Q for purchases and 1-2p+c/Q for sales.

Because the insider sets fully revealing prices and leaves the appropriate profit to the outsider, her expected utility is null:

$$E\left[U^{O}\left(W_0^{O}\right)\right]=0$$

The unconditional expected utility of the insider is given by:

$$\begin{aligned}E\left[U^{I}\left(W^{I}\right)\right]=&\frac{1}{2}p\frac{\lambda}{2}U^{I}\left[Q\left(2p-1-\frac{c}{Q}\right)\right]+\frac{1}{2}p\frac{\lambda}{2}U^{I}\left[-Q\left(2p-1+\frac{c}{Q}\right)\right]+\frac{1}{2}p(1-\lambda)U^{I}[0]+\\&\frac{1}{2}(1-p)\frac{\lambda}{2}U^{I}\left[Q\left(1-2p-\frac{c}{Q}\right)\right]+\frac{1}{2}(1-p)\frac{\lambda}{2}U^{I}\left[-Q\left(1-2p+\frac{c}{Q}\right)\right]+\frac{1}{2}(1-p)(1-\lambda)U^{I}[0]+\\&\frac{1}{2}(1-p)\frac{\lambda}{2}U^{I}\left[Q\left(2p-1-\frac{c}{Q}\right)\right]+\frac{1}{2}(1-p)\frac{\lambda}{2}U^{I}\left[-Q\left(2p-1+\frac{c}{Q}\right)\right]+\frac{1}{2}(1-p)(1-\lambda)U^{I}[0]+\\&\frac{1}{2}p\frac{\lambda}{2}U^{I}\left[Q\left(1-2p-\frac{c}{Q}\right)\right]+\frac{1}{2}p\frac{\lambda}{2}U^{I}\left[-Q\left(1-2p+\frac{c}{Q}\right)\right]+\frac{1}{2}p(1-\lambda)U^{I}[0]\end{aligned}$$

$$\begin{aligned}E\left[U^{I}\left(W^{I}\right)\right]=&-\frac{1}{2}p\frac{\lambda}{2}Q\left(2p-1+\frac{c}{Q}\right)+\frac{1}{2}(1-p)\frac{\lambda}{2}Q\left(1-2p-\frac{c}{Q}\right)\\&-\frac{1}{2}(1-p)\frac{\lambda}{2}Q\left(2p-1+\frac{c}{Q}\right)+\frac{1}{2}p\frac{\lambda}{2}Q\left(1-2p-\frac{c}{Q}\right)\end{aligned}$$

$$E\left[U^{I}\left(W^{I}\right)\right]=-\frac{\lambda}{2}Q(2p-1)-\lambda\frac{c}{2}$$

Again, the outsider’s individual rationality constraint is satisfied. The individual rationality constraint of the insider is satisfied if c<2Q(1-p). The previous tradeoff between the risk sharing gain and the cost of liquidity provision arises again. But it is now less prevalent since 2Q(1-p)>2λQ(1-p). This reflects the fact that, thanks to the preopening period, there is a better coordination between the demand and the supply of liquidity.

However, this situation is not an equilibrium since there exist profitable deviations for the insider. As earlier when he receives a good signal and a negative endowment shock, the insider will deviate and choose to set the price as if he had received a bad signal in order to decrease his buying price. The insider will also deviate when he receives a bad signal and a positive endowment shock. He will choose to set the price as if he had received a good signal in order to increase his selling price. The expected utility that the outsider gets if he deviates is:

$$E\left[U^{I}(W^{I})\right]=0$$

The insider's expected utility when deviating is greater than the one he obtains when following the strategy stated in the equilibrium conjecture. Consequently, this conjecture is not an equilibrium.

5.2) Infinite number of trading periods

In this subsection, we prove that, in the context of an infinitely repeated interaction, there exists an equilibrium where the outsider provides liquidity and the insider sets revealing prices. We also show that the presence of a preopening period increases the gains from trade. Acting as a preannouncement plate-form, this preopening period facilitates coordination of liquidity supply and demand. The truthfulness of the terms of trade preannounced by the insider is guaranteed by the fact that misleading announces would be punished. Punition takes the form of future denials of liquidity provision by the outside investor. Anticipating that not being able to share risk in the future would be damaging for him, the insider refrains from fooling the outside investor. In line with the observation of Admati and Pfleiderer (1991), in our model, the preopening period constitutes the formal mechanism for preannouncement to reach market participants. The repeated interaction is the technology for the enforcement of commitments made through preannouncements.
We assume that the asset value is realized after each trading period, that wealth is fully consumed, and that traders have inter-temporal expected utilities given by:

$$U^X(W^X) = \sum_{t=1}^{t=+\infty} \left\{ \delta^t E\left[U_t^X(W^X) \right] \right\}$$

The index X stands for O (outsider) or I (insider). δ is the rate at which future expected utility is discounted, with $0<\delta<1$.

Single Call Market - Consider first the case where the market is organized as a single call market.
Consider the following revealing equilibrium conjecture which is in the spirit of a trigger strategy equilibrium. As long as she does not detect a non revealing pricing by the insider, the outsider enters the market. The best she can do to provide liquidity to the market is to submit the following limit orders: buy Q shares with a limit price equal to $2p-1-c/\lambda Q$ and sell Q shares with a limit price equal to $1-2p+c/\lambda Q$. If she detects a non-revealing pricing by the insider, she stops entering the market and providing liquidity. The insider sets revealing prices that allow the outsider to break even.

Since the insider sets fully revealing prices and leaves her the appropriate surplus, the outsider's inter-temporal expected utility is null:

$$U^{O}(W^{O}) = \sum_{t=1}^{t=+\infty}\left\{\delta^{t} \times 0\right\} = 0$$

The Insider's inter-temporal expected utility is:

$$U^{I}(W^{I}) = \sum_{t=1}^{t=+\infty}\left\{\delta^{t}\left(-\frac{\lambda}{2}Q(2p-1)-\frac{c}{2}\right)\right\}$$

$$U^{I}(W^{I}) = \left(-\frac{\lambda}{2}Q(2p-1)-\frac{c}{2}\right)\sum_{t=1}^{t=+\infty}\left\{\delta^{t}\right\}$$

$$U^{I}(W^{I}) = -\frac{1}{2}\left(\lambda Q(2p-1)+c\right)\frac{1}{1-\delta}$$

If there is no trade, the inter-temporal expected utility of the insider is:

$$U^{I}(W^{I}) = \sum_{t=1}^{t=+\infty}\left\{\delta^{t}\left(-\frac{\lambda}{2}Q\right)\right\}$$

$$U^{I}(W^{I}) = -\frac{\lambda}{2}Q\frac{\delta}{1-\delta}$$

The insider's individuality constraint is satisfied as long as $p < \frac{1}{2}\left(1+\delta-\frac{c}{\lambda Q}\right)$.

Insider's conjectured strategy is an equilibrium strategy if no deviation is profitable. One may think there is an infinite amount of potential deviations: the insider could choose to deviate at the first n dates and then be truthful forever, with n being a finite number greater than or equal to 1. However, if such a deviation is found to be profitable, then after n trading rounds the trader faces exactly the same problem as initially. Thus, because of the infinitely repeated interaction, if n deviations are perceived to be profitable at date 0, then after n trading round, n deviations will again be profitable. The insider would end up trying to fool the outsider at each trading round. This contradicts the initial assumption that the insider would fool the outsider only n times and then be truthful forever. In the absence of a self-disciplining device, the only consistent deviation the insider can consider is to profit from his information as soon as it is possible. In this case, the inter-temporal utility of the insider would be:

$$U^I(W^I) = 0 + \frac{\lambda\gamma}{2}\left[\sum_{t=1}^{t=+\infty}\left\{\delta^t\left(-\frac{\lambda}{2}Q\right)\right\}\right] + \left(1 - \frac{\lambda\gamma}{2}\right)\left(\begin{array}{l} 0 + \frac{\lambda\gamma}{2}\left[\sum_{t=2}^{t=+\infty}\left\{\delta^t\left(-\frac{\lambda}{2}Q\right)\right\}\right] + \\ \left(1 - \frac{\lambda\gamma}{2}\right)\left(\begin{array}{l} 0 + \frac{\lambda\gamma}{2}\left[\sum_{t=3}^{t=+\infty}\left\{\delta^t\left(-\frac{\lambda}{2}Q\right)\right\}\right] \\ \ldots \end{array}\right)\end{array}\right)$$

$$U^I(W^I) = \sum_{t=0}^{t=+\infty}\left\{\left(1 - \frac{\lambda\gamma}{2}\right)^t \frac{\lambda\gamma}{2}\left(\sum_{s=t+1}^{s=+\infty}\left\{\delta^s\left(-\frac{\lambda}{2}Q\right)\right\}\right)\right\}$$

$$U^I(W^I) = \sum_{t=0}^{t=+\infty}\left\{\left(1 - \frac{\lambda\gamma}{2}\right)^t \frac{\lambda\gamma}{2}\left(-\frac{\lambda}{2}Q\frac{\delta^{t+1}}{1-\delta}\right)\right\}$$

$$U^I(W^I) = -\frac{\lambda^2\gamma}{4}Q\frac{\delta}{1-\delta}\sum_{t=0}^{t=+\infty}\left\{\left(1 - \frac{\lambda\gamma}{2}\right)^t\delta^t\right\}$$

$$U^I(W^I) = -\frac{\lambda^2\gamma}{4}Q\frac{\delta}{1-\delta}\frac{1}{1-\delta-\frac{\lambda\gamma\delta}{2}}$$

Deviating will not be profitable if:

$$-\frac{1}{2}(\lambda Q(2p-1)+c)\frac{1}{1-\delta} > -\frac{\lambda^2\gamma}{4}Q\frac{\delta}{1-\delta}\frac{1}{1-\delta-\frac{\lambda\gamma\delta}{2}}$$

This expression can be rewritten as:

$$p < T^{NoPP}$$

where

$$T^{NoPP} = \frac{1}{2} + \left(\frac{\lambda^2\gamma\delta}{2}Q\frac{1}{1-\delta-\frac{\lambda\gamma\delta}{2}} - c\right)\frac{1}{2\lambda Q}$$

To prove the existence of an equilibrium, let $\lambda=\gamma=½$, $\delta=¾$, c=100, and Q=10,000. Note that assumption A becomes p>51%, and that the insider's individual rationality constraint becomes p<86.5%. Under these parameters, T^{NoPP} equals 79%. The condition for the existence of an equilibrium thus becomes p<79%. Since the parameter p belongs to the interval]½,1[, there exists p such that the equilibrium condition, the assumption A, and the insider's individual rationality constraint are all satisfied. We thus conclude that there exists a set of parameters for which the conjecture stated above is an equilibrium.

Preopening Period and Call Market - Consider now the case where the market is organized as a preopening period followed by a call market.

Consider the following equilibrium conjecture. The insider preannounces his liquidity needs during the preopening period. He sets revealing prices that allow the outsider to break even. As long as she does not detect a non revealing pricing by the insider, when a liquidity need is preannounced, the outsider enters the market. She provides liquidity to the market by submitting the following limit orders: buy Q shares with a limit price equal to 2p-1-c/Q and sell Q shares with a limit price equal to 1-2p+c/Q. If she detects a misleading preannouncement or pricing by the insider, she stops entering the market and providing liquidity.

Since the insider sets fully revealing prices and leaves her the appropriate surplus, the outsider's inter-temporal expected utility is null:

$$U^O(W^O) = \sum_{t=1}^{t=+\infty}\left\{\delta^t \times 0\right\} = 0$$

The Insider's inter-temporal expected utility is:

$$U^I(W^I) = \sum_{t=1}^{t=+\infty}\left\{\delta^t\left(-\frac{\lambda}{2}Q(2p-1)-\frac{\lambda}{2}c\right)\right\}$$

$$U^I(W^I) = \left(-\frac{\lambda}{2}Q(2p-1)-\frac{\lambda}{2}c\right)\sum_{t=1}^{t=+\infty}\left\{\delta^t\right\}$$

$$U^I(W^I) = -\frac{\lambda}{2}\left(Q(2p-1)+c\right)\frac{1}{1-\delta}$$

The insider's individuality constraint is satisfied as long as $p < \frac{1}{2}\left(1+\delta-\frac{c}{Q}\right)$.

If the insider deviates and profits from his private information instead of setting revealing prices, he gets the inter-temporal utility computed before which is equal to:

$$U^I(W^I) = -\frac{\lambda^2\gamma}{4}Q\frac{\delta}{1-\delta}\frac{1}{1-\delta-\frac{\lambda\gamma\delta}{2}}$$

Deviating will not be profitable if:

$$-\frac{\lambda}{2}\left(Q(2p-1)+c\right)\frac{1}{1-\delta} > -\frac{\lambda^2\gamma}{4}Q\frac{\delta}{1-\delta}\frac{1}{1-\delta-\frac{\lambda\gamma\delta}{2}}$$

This expression can be rewritten as:

$$p < T^{PP}$$

where

$$T^{PP} = \frac{1}{2} + \left(\frac{\lambda\gamma\delta}{2}Q\frac{1}{1-\delta-\frac{\lambda\gamma\delta}{2}} - c\right)\frac{1}{2Q}$$

To prove the existence of an equilibrium, let λ=γ=½, δ=¾, c=100, and Q=10,000. Remind that assumption A becomes p>51%. The insider's individual rationality constraint becomes p<87%. Under these parameters, T^{PP} equals 79.5%. The condition for the existence of an equilibrium thus becomes p<79.5%. Since the parameter p belongs to the interval]½,1[, there exists p such that the equilibrium condition, the assumption A, and the insider's individual rationality constraint are all satisfied. We thus conclude that there exists a set of parameters for which the conjecture stated above is an equilibrium.

5.3) On the usefulness of the preopening period

What is the role of the preopening period in our model? In the preceding subsection, we showed that a revealing equilibrium with risk sharing exists whether or not there is a preopening period. This is because the insider fears the threats of future liquidity denials if he fools the outsider. In this subsection, we show that the presence of a preopening period increases the gains from trade, and favors the existence of the revealing equilibrium.

To prove that the presence of a preopening period increases the gains from trade, we have to show that the insider's utility is greater when there is a preopening period. This is equivalent to showing that:

$$-\frac{\lambda}{2}\left(Q(2p-1)+c\right)\frac{1}{1-\delta} > -\frac{1}{2}\left(\lambda Q(2p-1)+c\right)\frac{1}{1-\delta}$$

This inequality holds if c(1-λ)>0 which is true if λ<1. This means that, unless the insider always receives an endowment shock, the preopening period improves welfare. This result comes from the fact that the preopening period allows better coordination of the demand and the supply of liquidity. When there is no preopening period, the outsider always enters the market. On the opposite, when there is a preopening period, the insider preannounces his liquidity needs, and the outsider only enters the market after observing such preannouncement. The increase in the gains from trade derives from the savings on the cost of market participation.

The increase in the gains from trade due to the presence of a preopening period is equal to:

$$\frac{1-\lambda}{1-\delta}\times\frac{c}{2}$$

Simple computations show that the derivative of the increase in the gains from trade is negative with respect to λ, and positive with respect to δ and c. This means that the higher the probability of an endowment shock, the lower is the gains from a better coordination between the demand and the supply of liquidity. This is intuitive since, λ being greater, there are fewer cases in which, without preopening period, the outsider enters the market when her liquidity is not needed. On the other hand, the higher the cost of market participation the more welfare the agents can experience by better coordinating supply and demand of liquidity.

The set of parameters for which there exists an equilibrium is greater when there is a preopening period if the threshold T^{PP} is greater than T^{NoPP}. This is equivalent to:

$$\frac{1}{2}+\left(\frac{\lambda\gamma\delta}{2}Q\frac{1}{1-\delta-\frac{\lambda\gamma\delta}{2}}-c\right)\frac{1}{2Q}>\frac{1}{2}+\left(\frac{\lambda^{2}\gamma\delta}{2}Q\frac{1}{1-\delta-\frac{\lambda\gamma\delta}{2}}-c\right)\frac{1}{2\lambda Q}$$

This inequality holds if $c(1-\lambda)>0$ which is true if $\lambda<1$. Again, unless the insider always receives an endowment shock, the domain of existence of the revealing equilibrium is greater when there is a preopening period. Not only the presence of a preopening period improves welfare but also it favors the emergence of a revealing equilibrium with risk sharing.

The increase in the parameter region that sustains an equilibrium is equal to:

$$\frac{c}{2Q}\frac{1-\lambda}{\lambda}$$

One can show that the parameter region for which an equilibrium exists only if there is a preopening period is increasing in c, and decreasing in Q and λ. This suggests that the introduction of a preopening period is crucial when the cost of market participation is high, when the amount of trading needed is low, and when the probability of an endowment shock is low. In other words, the introduction of a preopening period can generate transactions even when the disposition to trade of the participants is weak. This property is exactly what is useful in the context of an emerging or for infrequently traded stocks.

To summarize, this subsection showed that the preopening period increase liquidity. Provided that an equilibrium exists under the two market structure (i.e. when $p< T^{NoP}$ and p<

T^{PP}), this increase in liquidity does not come from an increase in the trading volume. Indeed, with or without preopening period, the insider can trade Q units as soon as it needs to. However, the usefulness of the preopening period is materialized by a reduction in the execution costs incurred by the insider. This reduction in execution costs translates into an increase in traders' welfare. Interestingly, the liquidity improvement does not go along with an increase in the order flow. In fact, the reverse happens: when there is a preopening period, the outsider enters the market and submits orders (thus providing liquidity) only when there is a preannouncement. This creates the paradoxical situation where the existence of a preopening period reduces the order flow and, at the same time, improves market liquidity. As we explained earlier, it is precisely the reduction in the (costly) order placement that generates the welfare improvement. On the other hand, this subsection also shows that the existence of a preopening period can sustain an equilibrium that would not be otherwise achieved without preopening period (i.e. when $p > T^{NoP}$ and $p < T^{PP}$). In this case, without preopening period, there would be no trade, and the introduction of a preopening period would generate trading. Under this condition, liquidity is drastically improved by the existence of a preopening period, and this improvement goes along with a higher order placement and a higher trading volume.

6) Conclusion

This paper describes the liquidity and price formation process on the West-African Bourse. The market is organized as a preopening period followed by a call. We show that traders seem to use the preopening period to preannounce their liquidity needs. Large orders and quantities are indeed posted on the market long before transactions may occur. We also provide evidence that the indicative prices appear to reveal information. Early during the preopening period, we cannot reject the fact that indicative prices can predict future price evolutions.

We propose a model inspired from Admati and Pfleiderer (1991) that shows that these two phenomena are linked to the non-anonymity of the market, and the repeated interaction among market participants. The West-African Bourse is composed by only 16 brokers and is perfectly transparent. Such non-anonymity and repeated interaction among agents allow them to coordinate on strategies that improve market quality in the spirit of Benveniste, Marcus, and Wilhelm (1992).

In future research, it would be interesting to study liquidity and price formation on other emerging markets. A good candidate would be the Casablanca Stock Exchange. Indeed, some Morocco stocks are traded in a market similar to the one existing in West-Africa, namely a preopening period followed by a call. We conjecture that this market structure may enable investor on this exchange to implement sunshine trading and hence to enhance liquidity. It would also be interesting to use the type of model presented in our paper to estimate the cost of market participation in emerging stock markets.

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Table 1 – Trading activity

This table presents various measures of trading activity for the 8 stocks under study. The average and the standard deviation of the trading volume, and the average number of orders are computed over the 141 trading sessions in 2000. The turnover is defined as the total number of shares traded over the number of outstanding shares for the year 2000. The average and the standard deviation of the number of active broker-dealers are computed across the trading sessions with a non-null order placement. The average Herfindahl index and the average 1/number of broker-dealers are computed across the trading sessions with a non-null trading volume. BICC stands for Banque Internationale pour le Commerce et l'Industrie de Côte d'Ivoire. BLHC stands for Blohorn – Côte d'Ivoire. CIEC stands for Compagnie Ivoirienne d'Electricité. PALC stands for Palm – Côte d'Ivoire. SGBC stands for Société Générale de Banques en Côte d'Ivoire. SHEC stands for Shell – Côte d'Ivoire. SNTS stands for Société Nationale de Télécommunication. NA stands for "Not Available".

	BICC	BLHC	CIEC	PALC	SGBC	SHEC	SNTS	STBC
Average Volume	246	88	100	141	116	71	1719	73
Standard Deviation of the Volume	772	253	168	378	494	170	7211	295
Turnover	0.0231	NA	0.0050	0.0050	0.0053	0.0139	0.0242	NA
Number of Trading Sessions without Trades	54	38	24	73	105	33	3	57
Average Number of Orders	10	9	16	13	8	8	31	11
Proportion of Cancelled Orders (in %)	1.41	2.86	3.27	1.00	1.25	3.19	2.95	1.08
Proportion of Modified Orders (in %)	4.44	11.45	9.95	5.79	4.83	8.38	5.55	9.32
Average Number of Active Broker-Dealers	2.21	3.49	4.52	4.67	2.76	3.72	7.35	3.48
Standard Deviation of the Number of Active Broker-Dealers	0.98	1.44	1.44	1.54	1.05	1.47	0.26	1.77
Average Herfindahl Index	0.81	0.54	0.49	0.57	0.81	0.49	0.52	0.58
Average 1/number of broker-dealers	0.56	0.35	0.25	0.25	0.44	0.32	0.20	0.41

Table 2 – Broker-dealers' activity

This table presents the number of orders placed and the number of shares traded by each broker-dealer, averaged across stocks and trading sessions.

	Average Number of Orders	Average Number of Shares Traded
BD1	3.1	33
BD2	6.8	70
BD3	2.6	151
BD4	3.1	101
BD5	35.9	3117
BD6	5.7	334
BD7	0.4	8
BD8	2.4	20
BD9	0.0	0
BD10	1.1	126
BD11	0.2	3877
BD12	1.3	27
BD13	0.3	2
BD14	0.2	1
BD15	10.1	494
BD16	32.3	4779

Table 3 – Transaction costs

The measure of transaction costs we used is inspired by Kehr, Krahnen, and Theissen (1998). For each trading session, we added one buying market order in the orderbook, and computed the new transaction price (P_b). After canceling this buying order, we added one selling market order, and computed another transaction price (P_s). Transaction costs were measured by the following formula: $\frac{P_b - P_s}{P^*}$ where P^* was the actual transaction price. We computed this measure with orders of various sizes: one, ten, hundred, two hundred, five hundred, one thousand. For each stock, we computed the average transaction cost across trading sessions where the additional buy and sell orders could find a counterpart. The number of trading sessions (out of 141) in which the orderbook was not thick enough to allow execution of the additional orders is also provided.

	BICC	BLHC	CIEC	PALC	SGBC	SHEC	SNTS	STBC
Transaction cost for the trading of 1 additional share	5.0	3.8	2.5	9.2	3.3	1.9	1.7	3.3
Number of trading sessions without liquidity	99	84	66	84	130	65	26	92
Transaction cost for the trading of 10 additional shares	5.3	12.5	5.3	9.7	4.3	2.4	1.9	3.9
Number of trading sessions without liquidity	104	114	106	90	132	80	29	100
Transaction cost for the trading of 100 additional shares	6.2	16.4	5.2	10.9	3.9	3.6	2.6	5.6
Number of trading sessions without liquidity	122	121	134	96	135	108	64	129
Transaction cost for the trading of 200 additional shares	6.7	26.0	3.73	14.6	3.3	2.6	3.0	3.1
Number of trading sessions without liquidity	127	133	140	102	138	120	77	133
Transaction cost for the trading of 500 additional shares	10.0	59.5	*	16.7	3.3	4.5	4.0	3.9
Number of trading sessions without liquidity	134	139	141	113	138	130	95	138
Transaction cost for the trading of 1000 additional shares	16.4	*	*	22.7	5	4.8	5.6	*
Number of trading sessions without liquidity	138	141	141	126	139	135	105	141

Table 4 – Regression of the instantaneous price volatility onto the trading volume

This table presents the result of OLS regression of the absolute returns onto the trading volume. The return at date *t* is computed as the difference between the price at date *t* and the price at date *t-1*, divided by the price at date *t-1*. Only the days with a non-null trading volume are considered. The number of observations is consequently not the same for all the stocks. P-values are reported in parenthesis.

	Intercept *a*	**Coefficient *b***	**R^2**	**Number of Observations**
BICC	0.0041	-0.0000	0.00	87
	(0.15)	(0.78)		
BLHC	0.0027	0.0000	0.02	103
	(0.00)	(0.21)		
CIEC	0.0143	0.0000	0.00	117
	(0.00)	(0.74)		
PALC	0.0131	-0.0000	0.00	68
	(0.00)	(0.79)		
SGBC	0.0346	-0.0000	0.06	36
	(0.00)	(0.16)		
SHEC	0.0052	-0.0000	0.00	108
	(0.00)	(0.64)		
SNTS	0.0064	-0.0000	0.00	138
	(0.00)	(0.87)		
STBC	0.0076	0.0000	0.02	84
	(0.00)	(0.23)		

Table 5 – Distribution of orders according to their size and their time of placement during the preopening period

For each of the 8 stocks, orders are classified in sixteen categories according to the placement time quartile and the size quartile they belong to. Table 5 averages these data. The upper-left cell of the table represents the large orders placed early. The first quartile of placement time is on average 9:16 am. The second quartile of placement time is on average 9:39 am. The third quartile of placement time is on average 10:07 am. The first quartile of order size is on average 9 shares. The second quartile of order size is on average 32 shares. The third quartile of order size is on average 92 shares.

		Time of Placement				
		1st Quartile	2nd Quartile	3rd Quartile	4th Quartile	sum
Order Size	4th Quartile	6%	7%	6%	6%	25%
	3rd Quartile	7%	7%	5%	5%	24%
	2nd Quartile	7%	7%	6%	5%	25%
	1st Quartile	6%	5%	7%	8%	26%
	sum	25%	25%	25%	25%	100%

Table 6 – Proportion of orders executed at the call as a function of their size and placement time during the preopening period

For each size and time category, this table reports the proportion of orders (partially) filled at the time of the call, averaged across the 8 stocks.

		Time of Placement				
		1st Quartile	2nd Quartile	3rd Quartile	4th Quartile	average
Order Size	4th Quartile	25%	24%	35%	58%	36%
	3rd Quartile	32%	32%	36%	58%	39%
	2nd Quartile	37%	37%	41%	58%	43%
	1st Quartile	34%	34%	43%	53%	41%
	average	32%	32%	39%	57%	40%

Table 7 – Distribution of proposed quantities over the sixteen categories of orders

This table reports the proportion of the total quantity that has been proposed by each type of orders, averaged over the 8 stocks.

		Time of Placement				
		1st Quartile	2nd Quartile	3rd Quartile	4th Quartile	sum
Order Size	4th Quartile	17%	18%	23%	33%	91%
	3rd Quartile	2%	2%	1%	2%	6%
	2nd Quartile	1%	1%	1%	0%	2%
	1st Quartile	0%	0%	0%	0%	1%
	sum	19%	21%	25%	35%	100%

Table 8 – Proportion of the executed quantities proposed by each type of orders that are eventually executed

For each category, this table reports the proportion of quantities that have been exchanged at the time of the call, averaged across the 8 stocks. Potential rationing is not taken into account.

		Time of Placement				
		1st Quartile	2nd Quartile	3rd Quartile	4th Quartile	average
Order Size	4th Quartile	25%	24%	35%	58%	36%
	3rd Quartile	32%	32%	36%	58%	39%
	2nd Quartile	37%	37%	41%	58%	43%
	1st Quartile	34%	34%	43%	53%	41%
	average	32%	32%	39%	57%	40%

Table 9 – Price discovery regressions

This table presents the result of OLS regression of the returns from the previous trading session to the call onto the returns from the previous trading session to the first part of the preopening period. The return at date *t* is computed as the difference between the price at date *t* and the price at date *t-1*, divided by the price at date *t-1*. Only the days with a non-null trading volume are considered. The number of observations is consequently not the same for all the stocks. The data is conditional on the existence of indicative prices in the first part of the preopening period. This further reduces the number of observations. P-values are reported in parenthesis.

	Intercept *A* [1]	**Coefficient *B*** [1]	**R^2**	**Number of Observations**
BICC	0	1	1.00	20
BLHC	-0,0011	0.0148	0.00	45
	(0.18)	(0.74)		
CIEC	-0.0019	0.2395	0.12	62
	(0.55)	(0.00)		
PALC	-0.0049	0.7353	0.71	10
	(0.62)	(0.00)		
SGBC	-0.0608	0.3233	0.41	8
	(0.04)	(0.08)		
SHEC	-0.0013	0.5451	0.25	54
	(0.23)	(0.00)		
SNTS	0.0001	0.4446	0.44	69
	(0.91)	(0.00)		
STBC	-0.0012	0.8993	0.41	26
	(0.47)	(0.00)		

Table 10 – Information revealed in indicative prices

This table presents the result of OLS regression of the returns from the previous trading session to the next trading session onto the returns from the previous trading session to the first part of the preopening period. The return at date t is computed as the difference between the price at date t and the price at date t-1, divided by the price at date t-1. Only the days with a non-null trading volume are considered. The number of observations is consequently not the same for all the stocks. The data is conditional on the existence of indicative prices in the first part of the preopening period. This further reduces the number of observations. P-values are reported in parenthesis.

	Intercept *alpha* [1]	Coefficient *beta* [1]	R^2	Number of Observations
BICC	0.0052	0.9736	0.79	20
	(0.33)	(0.00)		
BLHC	-0.0021	0.0234	0.00	45
	(0.09)	(0.73)		
CIEC	-0.0036	0.1362	0.01	62
	(0.53)	(0.36)		
PALC	-0.0175	0.4496	0.45	10
	(0.13)	(0.03)		
SGBC	-0.0680	0.5485	0.44	8
	(0.10)	(0.07)		
SHEC	-0.0026	-0.0154	0.00	54
	(0.07)	(0.93)		
SNTS	0.0001	0.4871	0.33	69
	(0.97)	(0.00)		
STBC	-0.0012	0.8795	0.27	26
	(0.59)	(0.01)		

Table 11 – Information incorporated in prices

This table presents the result of OLS regression of the returns from the previous trading session to the next trading session onto the returns from the previous trading session to the current trading session. The return at date t is computed as the difference between the price at date t and the price at date t-1, divided by the price at date t-1. Only the days with a non-null trading volume are considered. The number of observations is consequently not the same for all the stocks. The data is conditional on the existence of indicative prices in the first part of the preopening period. This further reduces the number of observations. P-values are reported in parenthesis.

	Intercept *alpha*	**Coefficient *beta***	**R^2**	**Number of Observations**
BICC	-0.0052	0.9736	0.79	20
	(0.33)	(0.00)		
BLHC	-0.0011	0.8329	0.31	45
	(0.28)	(0.00)		
CIEC	-0.0029	1.2653	0.56	62
	(0.44)	(0.00)		
PALC	-0.0141	0.5556	0.52	10
	(0.17)	(0.01)		
SGBC	0.0297	1.4906	0.83	8
	(0.10)	(0.00)		
SHEC	-0.0026	0.3374	0.09	54
	(0.05)	(0.03)		
SNTS	-0.0008	0.8296	0.42	69
	(0.60)	(0.00)		
STBC	-0.0001	1.1069	0.85	26
	(0.95)	(0.00)		

Table 12 – Identification of insiders

This table reports the number stocks out of the 8 stocks in our sample a broker-dealer has been identified as insider. To identify insiders, for each stock and each broker-dealer, we regressed the future return at date t onto the signed position taken by the broker-dealer at date t. We consider a positive coefficient to constitute an insider detection when the p-value is smaller than or equal to 10%. The future return at date t is computed as the difference between the price at date t+1 and the price at date t, divided by the price at date t. Only the days with a non-null trading volume are considered.
BD stands for broker-dealer.

	Number of identifications as insiders
BD1	1
BD2	0
BD3	1
BD4	2
BD5	0
BD6	0
BD7	0
BD8	0
BD9	0
BD10	1
BD11	0
BD12	0
BD13	0
BD14	0
BD15	0
BD16	0

Figure 1 – Volume and Price over the 141 trading sessions in our sample

Figure 1 Panel A – BICC

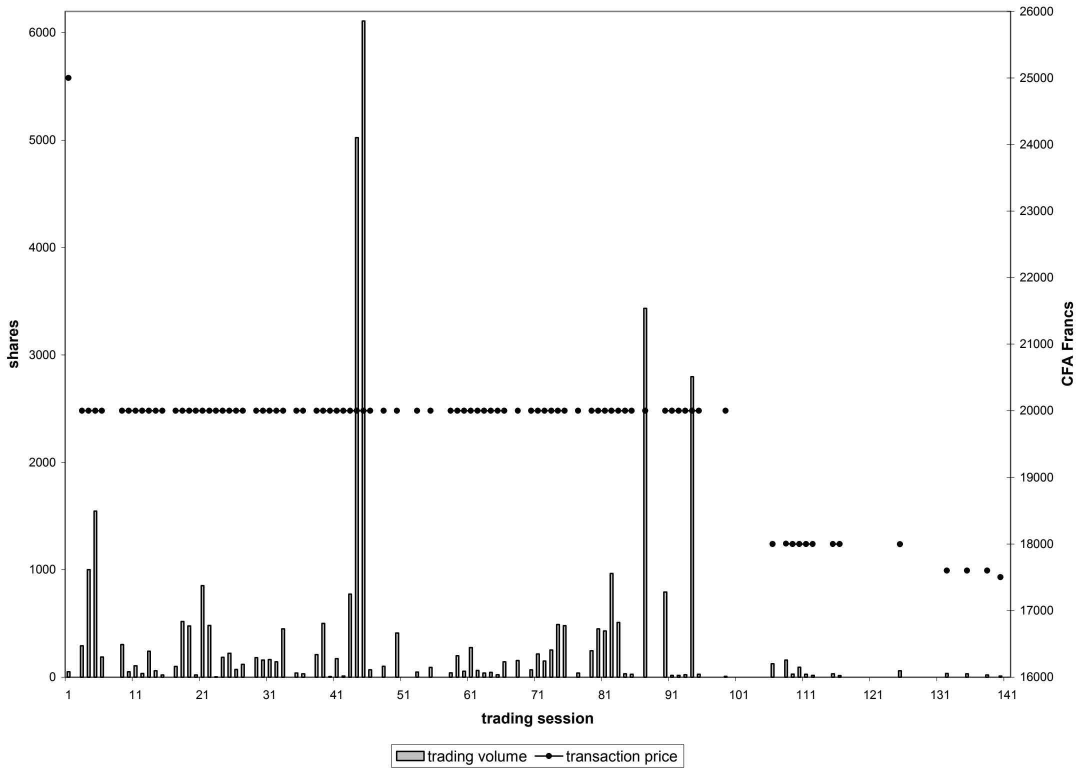

Figure 1 Panel B – BLHC

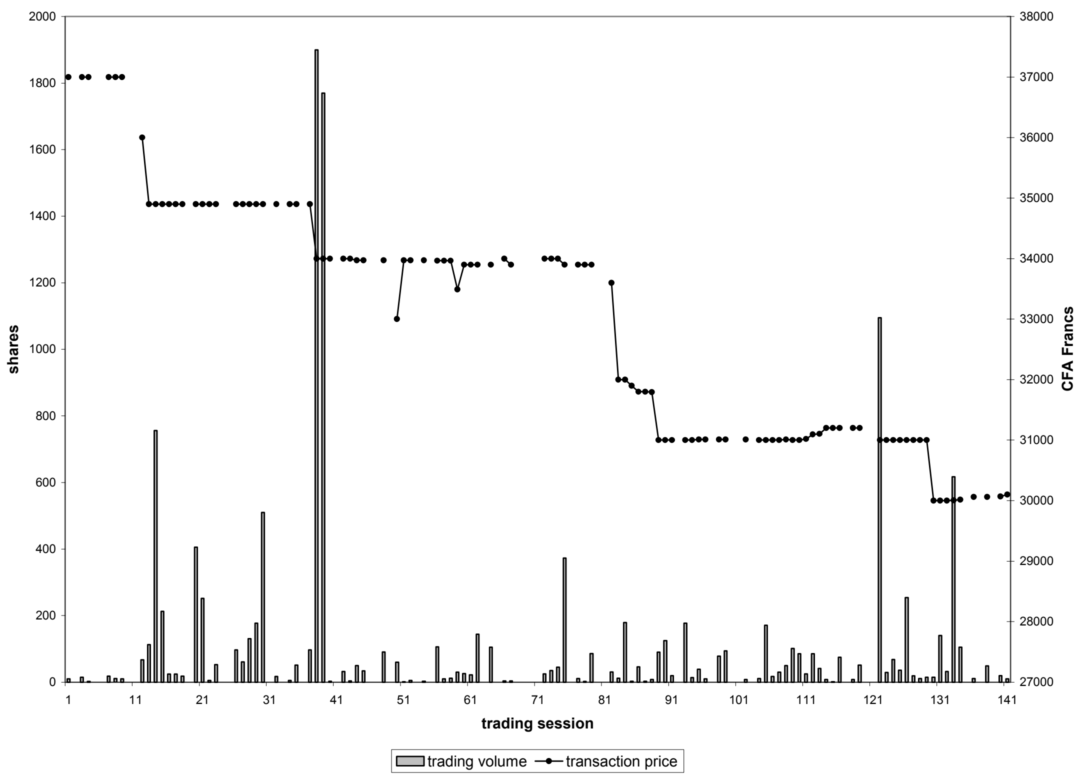

Figure 1 Panel C – CIEC

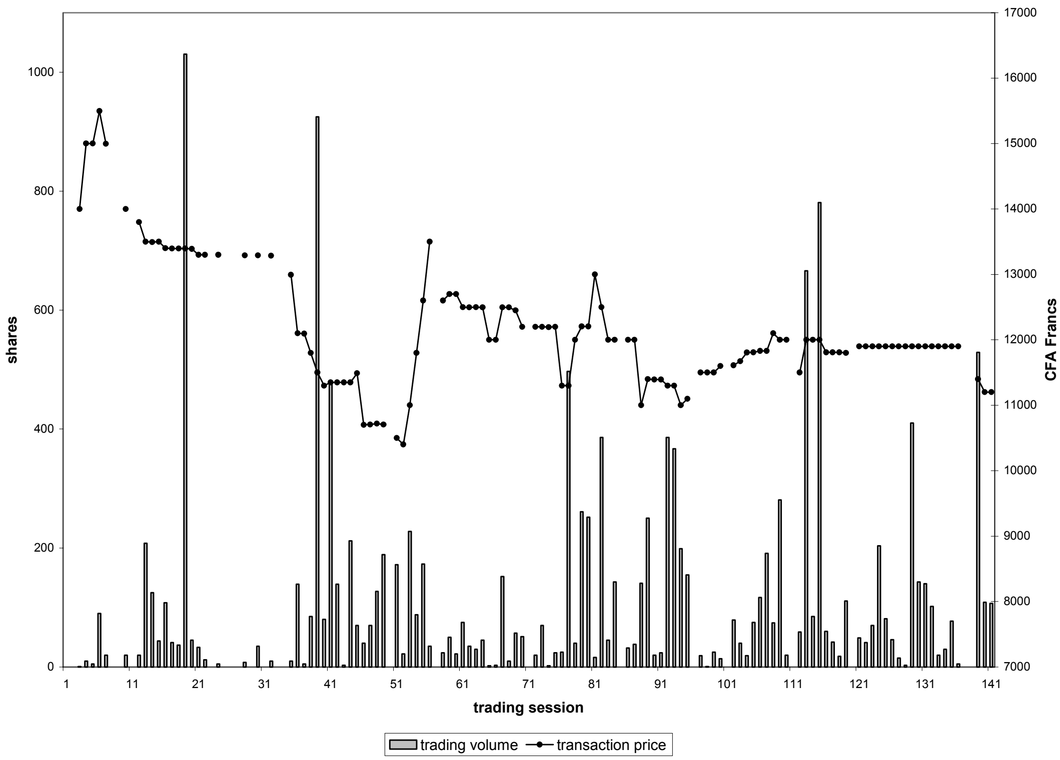

Figure 1 Panel D – PALM

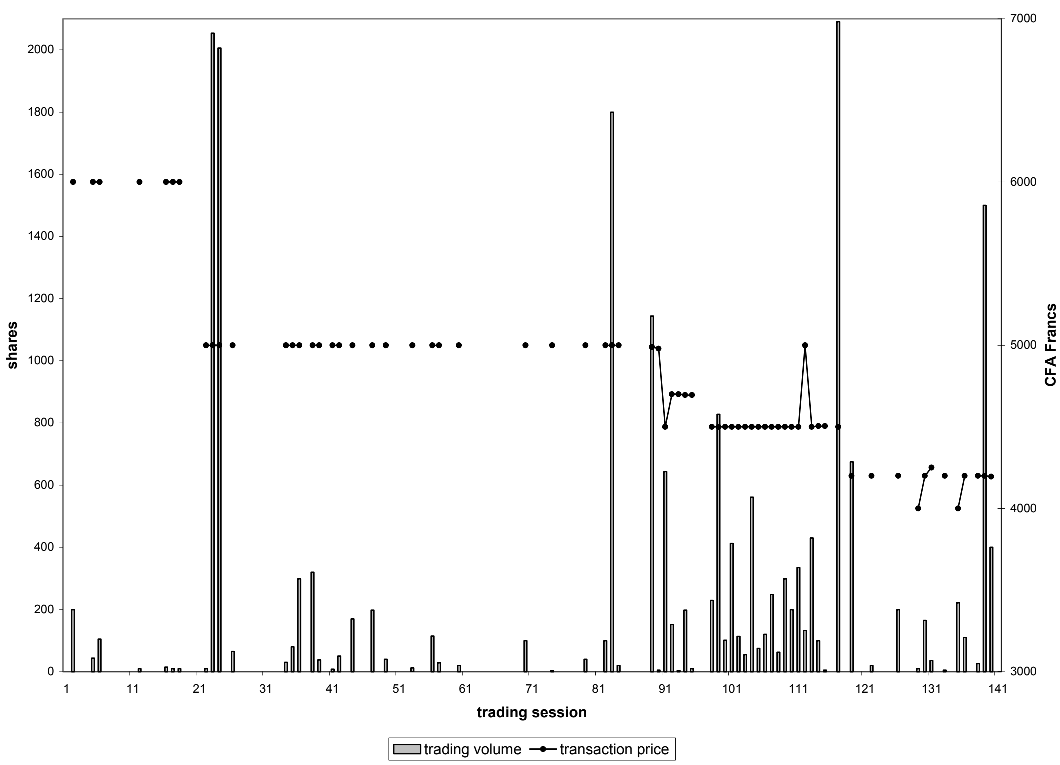

Figure 1 Panel E – SGBC

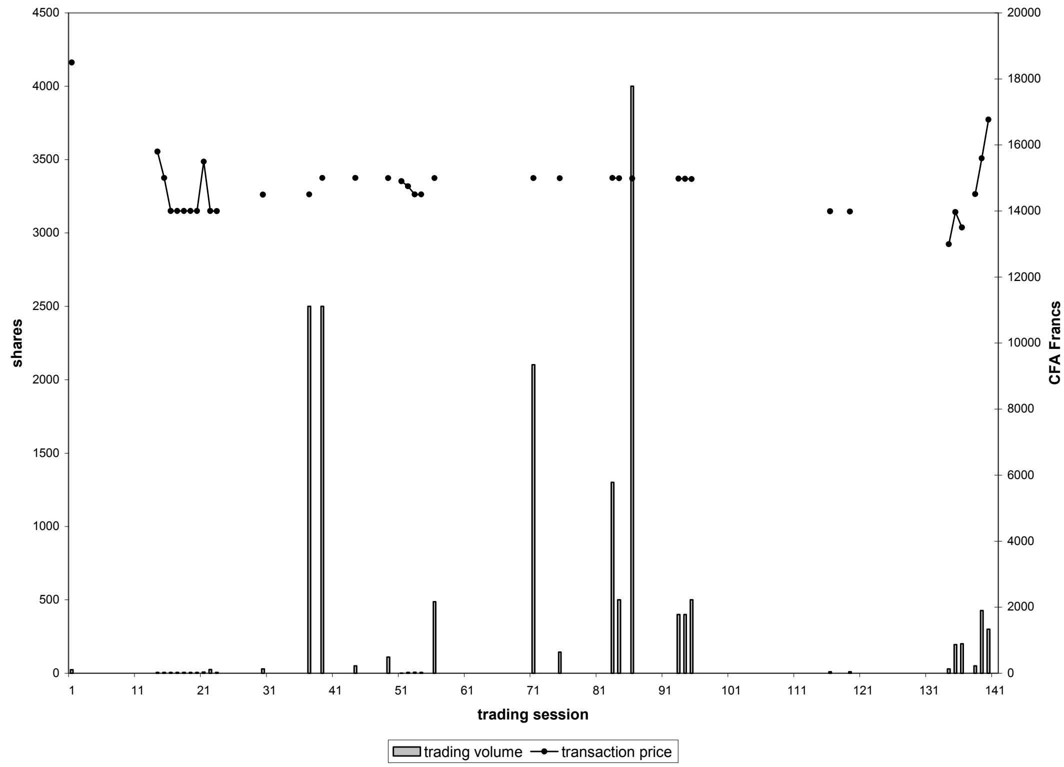

Figure 1 Panel F – SHEC

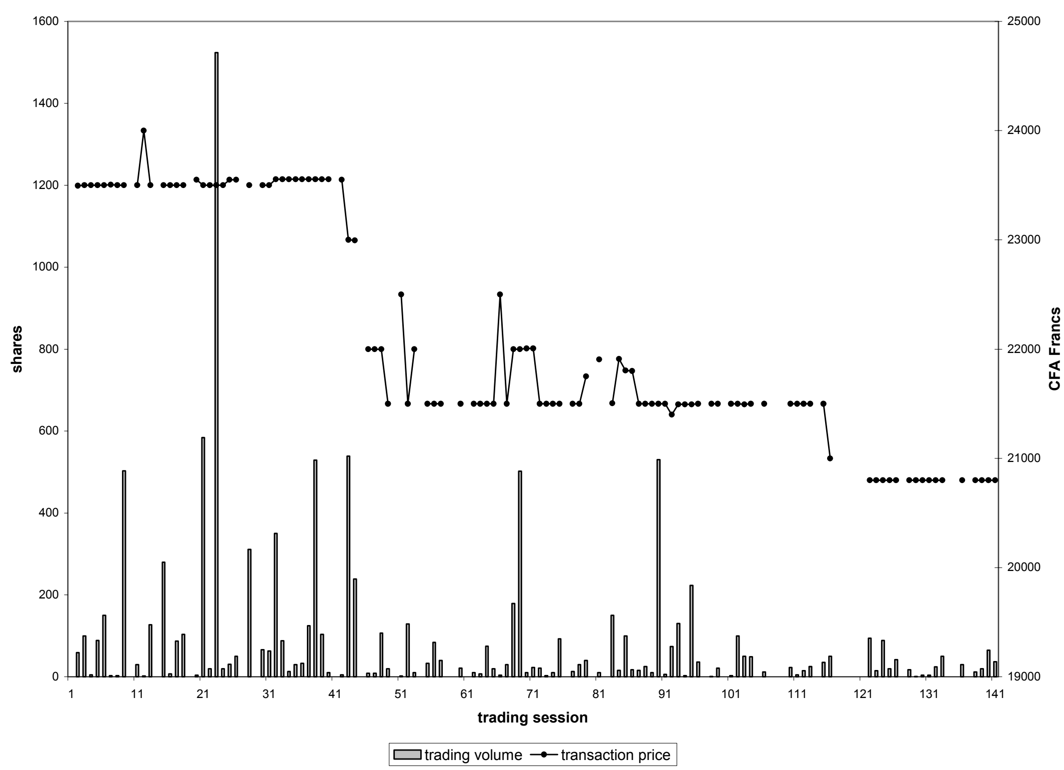

Figure 1 Panel G – SNTS

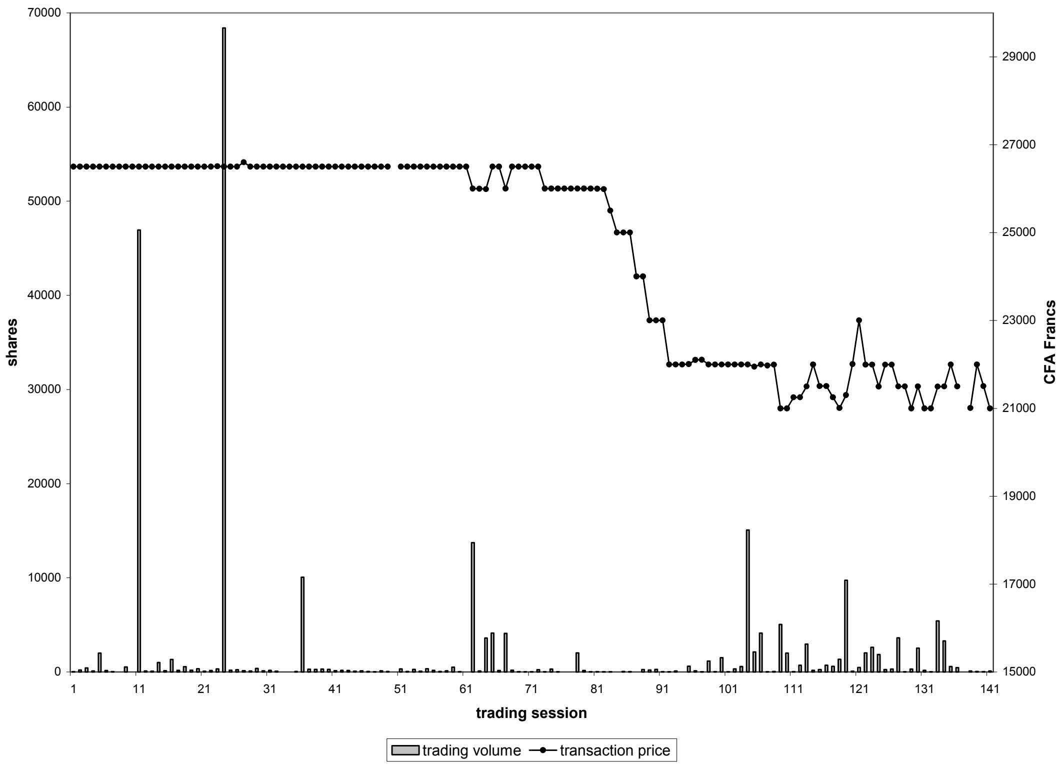

Figure 1 Panel H – STBC

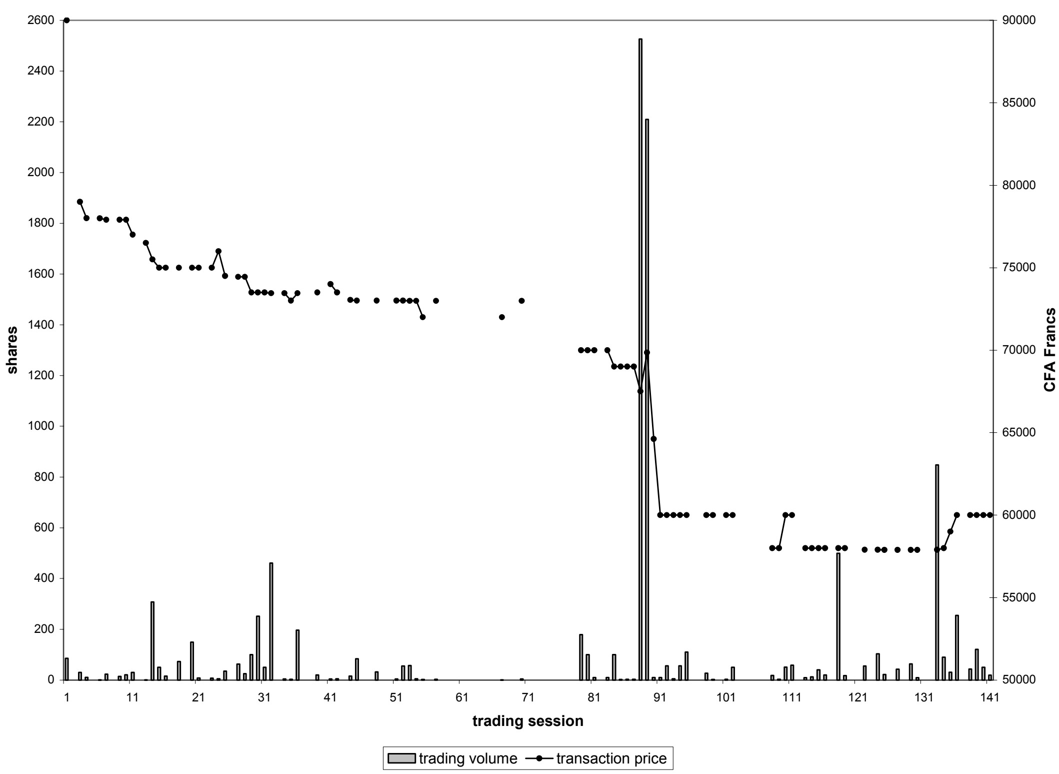

Figure 2 – Large orders in the preopening period

This figure represents the distribution of large orders (i.e. orders pertaining to the 4th and 3rd size quartiles) over the four time quartiles of the preopening period. It also indicates the amount of orders executed in each time quartile. The numbers are averages across stocks, and across the 2 size quartiles.