Commonality In Liquidity: Lessons From An Emerging Stock Market

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ABSTRACT

This study investigates commonality in liquidity in Tunisia, an order-driven, emerging stock market. We analyze the impact of information flow on the relationship between market liquidity and liquidity of securities, in addition to firm size and industry determinants. The effect of liquidity commonality on the liquidity of securities depends on firm size. The effect of market-wide commonality on liquidity is found to be stronger than that of industry-wide commonality. Our results show that public and private information flows improve liquidity. Systematic trading volume dominates systematic order imbalance in explaining liquidity; however, this effect is lesser compared to that of market liquidity.

Keywords: bid-ask spread; depth at-best limit; private information; public information; market model, emerging order-driven market, and microstructure.

1. INTRODUCTION

The search for an explanation for return volatility and liquidity is well documented in the literature on financial market microstructure. In the extant literature, financial researchers explained return volatility and liquidity from an individual perspective; i.e., they showed that the determinants mainly depend on the specific characteristics of each individual security. However, the evaporation of liquidity during the Asian crisis in 1997–1998 motivated financial researchers to explore systematic liquidity as a determinant of liquidity, known as commonality in liquidity.

Chordia et al. (2000)[1] were the first to explore systematic determinants. The authors reported the existence of variables or phenomena that explained the liquidity of all the securities listed in the price-driven market. Recently, some researchers focused on order-driven markets.[2] The development of this stream of literature can be explained by the improvements in information technology and the modernization of the legal framework. Brockman and Chung (2002) show that the order-driven market is more susceptible to commonality in liquidity than the price-driven market.

Commonality in liquidity has many important economic and financial implications. Firstly, commonality in liquidity of stocks has important implication for investors. There is empirical evidence that liquidity commonality is a systematic risk factor and that investors require compensation for a stock whose liquidity co-moves with market liquidity (e.g., Acharya and Pederson, 2005; Lee, 2011). Therefore, understanding the dynamics of liquidity in the financial market can help investors to improve their trading strategies by avoiding liquidity risks, which would lead to the optimal allocation of the investors' resources by increasing their confidence level (Chordia et al., 2003). Secondly, commonality in liquidity appears to be very important for central banks and regulators. Several studies showed that the financial turmoil during the 1990s was triggered by a commonality in liquidity shock. According to

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[1] Chordia et al. (2000) report several reasons for the existence of commonality in liquidity: variation in trading volume, volatility, and information asymmetry.

[2] Handa et al. (1998: 48) reported, "Unlike to the price-driven market, the provision of liquidity in an order-driven market has received relatively little attention in the literature of microstructure."

Fernando and Herring (2003), commonality in liquidity shocks affects the investors' beliefs about market trends and lead to a market drop. Coughenour and Saad (2004)[3] argued that the existence of commonality in liquidity could help researchers in finance to understand the dynamics of liquidity while helping the regulators and other participants to improve the market design.

Due to these important implications, many researches have been interested in commonality in liquidity, and different empirical tools have been proposed to explain commonality in liquidity in different contexts. Chordia et al.'s (2000) seminal paper used a simple market model adapted to market liquidity, for a market portfolio composed of 1,169 shares listed on the New York Stock Exchange (NYSE) in 1992. Chordia et al. (2000) showed that firm-level liquidity, in terms of spread as well as depth, is significantly explained by the changes in market liquidity. This common component remains significant even after controlling for individual determinants of liquidity, including price, volume, and volatility. Hasbrouck and Seppi (2001) used principal component analysis (PCA). Through a cross-sectional sample of 30 stocks with the highest level of liquidity on the NYSE in 1994, they showed that the phenomenon of commonality characterizes the order flows and returns. Huberman and Halka (2001) studied a sample of the NYSE composed of 240 shares in 1996, divided into four quartiles of 60 shares each. Their contribution lies in the use of both the dimensions derived from the bid-ask spread to measure liquidity—the absolute spread ratio and the spread/mid-quote ratio. In addition to these variables, they used two dimensions derived from the depth at-best limit: depth in quantity and depth in dollars. They highlighted the presence of a common liquidity shock.

Fabre and Frino (2004) were the first to investigate commonality in liquidity in the Australian Stock Exchange market. Using a market model and a sample of 660 individual securities from the year 2000, the authors confirmed the existence of commonality in liquidity on the Australian stock market. However, the commonality was found to be low compared to that reported for the NYSE market.

Brockman and Chung (2006) studied the Stock Exchange of Hong Kong (SEHK) market during the period May 1996 to December 1999. They used a market model for the four stock indices available on Hong Kong's futures exchange. The authors showed that the securities components of the four indices are more sensitive to exposure to liquidity commonality compared to the securities that do not belong to these indices. Brockman and Chung (2008) studied the same phenomenon in an order-driven context during a period of market stress (May 1996–December 1999). They reported a consistent increase in systematic liquidity during the market crash.

Pukthuanthong-Le and Visaltanachoti (2009) examined commonality in liquidity of the Stock Exchange of Thailand (SET) using limited order book data from 1996 to 2003. They found strong evidence for market-wide commonality in liquidity, which prevailed across several liquidity measurements. Industry-wide commonality was found to be stronger than market-wide commonality in liquidity

Karolyi et al. (2012) used the daily data of 27,447 securities from 40 developed and emerging equity markets over the period January 1995 to December 2009. They showed that the commonality in liquidity was very high during periods of high market volatility; they found that the existence of a large number of foreign investors and the adoption of strategies was related to this correlation.

More recently, using a sample of liquid stocks and options from emerging order-driven markets, Syamala et al. (2014) examined the existence of liquidity commonality for equity and options markets. They showed that the market-wide and industry-wide commonality remain important even after controlling the specific variables related to the security and after accounting for the underlying stock market liquidity and implied volatility (for options).

In a sample of the Taiwan Stock Exchange (TWSE), Lowe (2014) documents that stocks with greater liquidity commonality are related to higher aggregate ownership by qualified foreign institutional investors (QFIIs), mutual funds, and securities dealers. This positive ownership–commonality association is more pronounced during

[3] Coughenour and Saad (2004) argued that understanding the sources of commonality in liquidity is very important for the participants in the stock market. They added that an investigation of the sources of liquidity commonality could help investors to cope more efficiently with the risks generated by this commonality.

crash market. In addition, Mayordomo, Rodriguez-Moreno and Peña (2014) suggested the existence of significant liquidity commonalities in the corporate Credit Default Swap (CDS) market.

Most of these studies focused on developed, quote-driven markets. Very few studies attempted to understand the case of emerging markets. However, liquidity is more critical for emerging markets than for developed markets. In this paper, we focus on an emerging market. The main objective of this study is to complement the existing literature by studying the Tunisian stock market, an emerging market that operates with no market maker. It is our belief that our findings will shed light on commonality in liquidity in other emerging markets.

In this study, we apply the market model approach proposed by Chordia et al. (2000) to a sample covering (in terms of intra-day frequency) the 38 stocks that were continuously quoted on the Tunisian Stock Exchange (TSE) market during the period October 2008 to June 2009. Our study is different from previous empirical works on several counts. Firstly, most prior studies dealt with the importance of information flow for developed markets, highly liquid stock markets in industrial countries, and the Asian stock markets. There are no studies that focused on the North African capital markets. Although the Tunisian market is a growing market in the financial world, it has not been investigated up to now. Secondly, our study completes the existing literature on commonality in liquidity by simultaneously examining the effects of the public and private flow of information on the relationship between the market liquidity and the liquidity of securities. Thirdly, to the best of our knowledge, ours is the first study to investigate the dynamic interaction between information flow and this relationship in the stock market.

Our analysis has important implications for academics, regulators, and investors. First, a study of the commonality in liquidity in an emerging stock market such as the Tunisian market is important for understanding the process of price formation and liquidity. Second, besides the specific determinants related to individual securities, there are systematic market and industry factors that affect liquidity. Understanding the factors affecting liquidity would increase the level of confidence among investors by helping them understand the functioning of the market. Third, the existence of systematic liquidity in the Tunisian market is important because it obligates the financial authorities to take steps to avoid the dangers of the sudden evaporation of liquidity.

The rest of this paper is organized as follows. Section 2 explains the market structure and the data. Section 3 presents the empirical methodology and results, and Section 4 concludes the paper.

2. MARKET STRUCTURE AND DATA

2.1 Market Structure

The Tunisian stock exchange market (TSEM) is a centralized market, governed by the orders of and controlled by the Council of Financial Markets (CFM). The TSEM was organized by the Law on Financial Market Reorganization, No. 94-117, dated 14 November 1994. However, this legislation was found to be inadequate for the development of the TSEM, which motivated the authorities to modify the earlier law to Law No. 99-92 on 17 August 1999 after the recovery of the financial market. In a similar context, Law No. 2005-96 on the Strengthening of Financial Security and Transparency was passed on 18 October 2005. In addition to the legal reforms, an electronic trading system called SUPER-CAC UNIX was introduced on 25 October 1996. On 3 December 2007, the TSE launched a new version of the electronic trading system, V900, which was developed by Atos Euronext.

In October 2008, the TSE extended the duration of the trading session from 2 hours to 5 hours 10 minutes. The main market is now open from 09:00 am to 02:10 pm. The purchase and sell orders submitted by investors that are introduced into the quotation system are confronted depending on the degree of liquidity in two ways: the fixing quotation and the continuous quotation mode. All these reforms contributed to enhancing the stock market, increasing the trading activity, and restoring the investor confidence, which led to an evolution in the liquidity. The trading day in the Tunisian stock market pre-opens from 09:00 am to 10:00 am. During this period, the purchase orders and sales orders are entered into the system without affecting the transactions. As soon as the market opens, the system determines an opening price that will be used only for the transactions made by the opening auction at

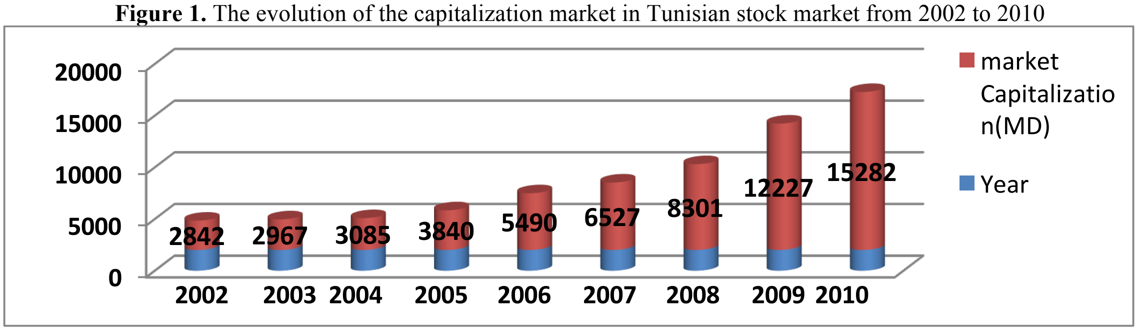
10:00 am. After the opening of the market and during the continuous session that lasts from 10:00 am to 02:00 pm, the introduction of an order in the system can generate an instantaneous transaction when there is an opposite order.

2.2 Data

In this study, we use a sample of 38 shares quoted on the continuous trading session during the period October 2008 to the end of June 2009. The TSM contains 50 securities, we exclude 12 shares quoted on fixing quotation because the law of supply and demand is not involved in this type of trading. Two intraday files compose our database[4]: a trading (transaction) file and the quotes file. The transaction file contains the intraday transaction prices and quantities along with the code of each stock on the transaction system, the date, and the transaction time. The second file includes the set of limit order purchases and sales along with the code of each purchase order and sale order, the date and time of entry of the order, the ASK price, the BID price entered by the intermediary stock exchange, and the quantity appropriate for each ASK price and BID price.

The choice of the period (October 2008–June 2009) is justified through two reasons. First, After October 2008, the TSM extended the duration of the trading session by two hours for duration of five hours and 10 minutes. Since then, the main market has operated from 9 am to 2:10 pm. This new market situation prompted us to select the period 2008 to 2009 to investigate the commonality in liquidity. Second, despite that this period is an exceptionally volatile period in the history of stock market, the Tunisian stock market has experienced enormous evolution of the market capitalization. Figure 1 reveals the evolution of the capitalization market from 2002 to 2010.

Figure 1. The evolution of the capitalization market in Tunisian stock market from 2002 to 2010



The details of this descriptive analysis are presented in Table 1. To conduct our research; this table shows that the daily average of trading volume per session during our retained period is about 34 transactions. The average number of transactions traded per day is 17,506. In addition, it is clear that the number of sale orders exceeds the number of purchase orders. The total amount of transactions performed during the period of study was 121 399 567.

Table 1. Descriptive statistics over the period October 2008 - June 2009

Variables	Value
Number of companies	38
Trading days	184
Number of transactions	240564
Quantities of transactions	121399567
Daily Average of the number of transactions by stock	34
Total maximum quantity traded for Attijari Bank	20163175
Total minimum quantity traded for BTE-ADP	119409
Average daily of trading volume by the action	17506
Number of purchase orders submitted	170413
Quantities of stocks submitted by purchase orders	130262717
Number of sale orders submitted	158099
Quantities of stocks submitted by sale orders	130616034

[4] We note that authors were funded by their proper the database.

2.2.1 Variables Definitions and Summary Statistics

In our analysis, we use two liquidity indicators: the bid-ask spread and the depth at-best limit. Contrary to previous studies such as Chordia et al. (2000), Brockman and Chung (2002), and Pukthuanthong-Le and Visaltanachoti (2009), we use the actual value and not the relative variations in order to represent liquidity. This is justified for two reasons. (i) Certain equity securities listed on the TSM were relatively illiquid. (ii) We obtained a series that suffered from missing interval observations. Therefore, applying Chordia et al.'s (2000) method on our data would not produce consistent results. The quoted spread represents the difference between the best of limited price of purchase and the best of limited price of sale.

$$QSPR_t = [(P_B) - (P_A)] \quad (1)$$

where $QSPR_t$ represents the quoted spread at interval t; P_B is the best limit price to buy (BID) at interval t; and P_A is the best limit price to sell (ASK) at interval t. Thus, the depth indicates the quantity available for purchase and sale for each price level at a given instant.

$$DEP_t = \frac{(Q_B + Q_A)}{2} \quad (2)$$

where DEP_t is the depth at interval t; Q_B is the quantity available at the purchase price at interval t; and Q_A is the quantity available at the selling price at interval t.

The below table presents the descriptive statistics for the market-wide liquidity measures used in this study. As was anticipated, the coefficient of Skewness is positive for both the indicators of liquidity (0.7281 for the bid-ask spread and 0.1822 for the depth at-best limit). This result implies that the empirical distribution of the two variables is asymmetric. More specifically, the results show that the distribution of the bid-ask spread and the depth at-best limit is leptokurtic. That is, both samples have distributions that are characterized by thicker tails at the end than that of the normal distribution. Thus, it is crucial to note that the depth at-best limit is more volatile over time compared to the bid-ask spread. This result is similar to that reported in Chordia et al. (2000).

Table 1. Cross-sectional statistics for time series means

	Mean	Median	Std. Dev	Skewness	Kurtosis
Bid-ask spread	-0.2097	-0.0626	0.6599	0.7281	281.9321
Depth at-best limit	2.9018	2.6182	2.4698	0.1822	2.1645

3. EMPIRICAL ANALYSIS

3.1 Evidence of Liquidity Commonality

A market model approach similar to that proposed by Chordia et al. (2000) is used for our initial estimates of liquidity commonality. The model is as follows:

$$L_{j,t} = \alpha_j + \beta_1 L_{M,t} + \beta_2 L_{M,t+1} + \beta_3 L_{M,t-1} + \delta_1 R_{M,t} + \delta_2 R_{M,t+1} + \delta_3 R_{M,t-1} + \delta_4 R^2{}_{j,t} + \varepsilon_{j,t} \quad (3)$$

where $L_{j,t}$ is the liquidity of stock j at the interval t. To represent this liquidity, we use the quoted bid-ask spread and the depth at-best limit. $L_{M,t}$ is the weighted cross-sectional average of the liquidity variable for the market. $L_{M,t+1}$ and $L_{M,t-1}$ represent the one-period lead and the lag of the market average liquidity variable, respectively, which are included to allow for non-contemporaneous adjustments in liquidity caused by thin trading. $R_{M,t}$, $R_{M,t+1}$ and $R_{M,t-1}$ represent the concurrent, lead, and the lag of the equally weighted market returns, respectively. The role of these variables is to remove any spurious dependence in the relationship between returns and liquidity measures.

$R^2{}_{j,t}$ is the return volatility for firm j at the interval t; it is measured as the average squared return. It is included as a proxy for return volatility, which could influence the liquidity variables. All market average liquidity variables are calculated using all the firms in the market except firm j. The same approach is used when calculating the market return ($R_{M,t}$,$R_{M,t+1}$,$R_{M,t-1}$). Further, we can deduce from the extant empirical literature that all the explanatory variables included in the market represent the control variables except the variable of contemporaneous market liquidity.

Table 2. Market-wide commonality in liquidity on the Tunisian Stock Exchange

	Depth at–best limit								**The bid-ask spread**							
	Concurrent		**Lead**		**Lag**		**Sum**		**Concurrent**		**Lead**		**Lag**		**Sum**	
	β_1	*t_stud*	β_2	*t_stud*	β_3	*t_stud*	$\beta_1+\beta_2+\beta_3$	*t_stud*	β_1	*t_stud*	β_2	*t_stud*	β_3	*t_stud*	$\beta_1+\beta_2+\beta_3$	*t_stud*
Mean of estimated coefficient	0.401	5.217	0.213	3.081	0.203	2.914	0.817	7.341	0.072	1.084	0.078	0.941	0.09	1.214	0.24	0.019
Number of firms (percent) with a positive coefficient and insignificant *t*-statistic	0(0%)		5(13.16%)		7(18.42%)		1026%)		28(73.68%)		29(76.32%)		24(63.16%)		20(52.63%)	
Number of firms (percent) with a positive coefficient and significant *t*-statistic	38(100%)		33(86.84%)		29(76.32%)		2874%)		9(23.68%)		5(13.16%)		11(28.95%)		17(44.74%)	
Number of firms (percent) with a negative coefficient andinsignificant*t*-statistic	0(0%)		0(0%)		2(5.26%)		0(0%)		1(2.63%)		4(10.53%)		3(7.89%)		1(2.63%)	
Number of firms (percent) with a negative coefficient and significant t-statistic	0(0%)		0(0%)		0(0%)		0(0%)		0(0%)		0(0%)		0(0%)		0(0%)	

Notes: the *t_stud*: is the student statistic. The significance of the coefficients is determined as follows: if *t_stud* > 2.5759, the coefficient is significant at 1%; if 1.96 < *t_stud* < 2.5759, the coefficient is significant at 5%; if 1.6449 < *t_stud* < 1.96, the coefficient is significant at 10%. This note is valuable for all flowing tables.

Table 2 reports the regression results of the model (equation 3). For the depth at-best limit, the mean coefficient of the concurrent market liquidity variable is 0.401, with an associated *t*-statistic of 5.217. All the individual coefficients are positive and significant for the whole sample. This result confirms the existence of a significant commonality in liquidity on the TSEM. Thus, the values of the sum of all the liquidity coefficients ($\beta_1 + \beta_2 + \beta_3$) are highly significant, implying a permanent positive effect of market liquidity on the liquidity of the securities. The coefficient β_1 is much smaller than that estimated by Chordia et al. (2000: 1.373), Brockman and Chung (2002: 0.438), and Pukthuanthong-Le and Visaltanachoti (2009: 0.414); the finding was similar in the case of the bid-ask spread.

For the bid-ask spread, the average coefficient of the concurrent market liquidity variable ($L_{M,t}$) is 0.072, with an associated *t*-statistic of 1.084. The estimated coefficient (β_1) is positive and significant for 23.68% of the firms, positive and not significant for 73.68%, and negative and insignificant for 2.63% of the firms. The sum of all the liquidity coefficients ($\beta_1 + \beta_2 + \beta_3$) is insignificant and positive. This result provides that the liquidity of Tunisian stocks do not respond significantly to the market-wide liquidity across time.

These results show that: (i) commonality in liquidity is a very important source of the liquidity of securities on the TSE; and (ii) the liquidity commonality related to the depth at-best limit dominates the commonality in liquidity related to the bid-ask spread in explaining the liquidity of securities. These empirical findings reveal the significance of commonality in liquidity in an order-driven market structure such as the Tunisian stock market.

3.2 Commonality in Liquidity and Size Effect

Chordia et al. (2000), Brockman and Chung (2002), and Fabre and Frino (2004) reported the effect of size on the degree of commonality in liquidity. However, the strategy of exploring the liquidity effect by segregating based on the size effect could result in lower explanatory power of the model due to variations in firm-specific effects over time (Cao and Wei, 2010) or due to the non-inclusion of some systematic factors in equation 3. Therefore, we propose a new strategy to avoid such problems. We construct four portfolios corresponding to the quartiles[5] determined by the market capitalization of the companies; subsequently, we estimate the model (equation 3) for the four quartiles. Table 3 presents the results.

[5] The first quartile includes securities whose market capitalization is the smallest; the fourth quartile includes the largest number of securities whose market capitalization is high. Asking for authors can transmit the classification of different quartiles.

Table 3. Market-wide commonality in liquidity according to size on the Tunisian Stock Exchange

Panel A: Liquidity≡Bid-ask spread

Size of quartile	Number of firms	Coefficient β_1 of market liquidity ($L_{M,t}$) Mean	Median	Number of firms (percent) with a positive coefficient ($\beta1$) and significant *t*-statistic	Number of firms (percent) with a positive coefficient (β_1) and insignificant *t*-statistic	Number of firms (percent) with a negative coefficient (β_1) and significant *t*-statistic	Number of firms (percent) with a negative coefficient (β_1) and insignificant *t*-statistic	Sum $\beta_1+\beta_2+\beta_3$	***t_stud***
Quartile 1	10	0.036	0.018	1 (10%)	9 (90%)	0 (0%)	0 (0)	0.105	-1.516
Quartile 2	9	0.024	0.026	2 (22%)	6 (67%)	0 (0%)	1 (11%)	0.086	0.109
Quartile 3	10	**0.123**	0.046	1 (10%)	9 (90%)	0 (0%)	0 (0%)	**0.431**	0.373
Quartile 4	9	0.102	0.07	5 (56.56%)	4 (44.44%)	0 (0%)	0 (0%)	0.332	1.243

Panel B: Liquidity≡Depth at-bestlimit

Size of quartile	Number of firms	Coefficient β_1 of market liquidity ($L_{M,t}$) Mean	Median	Number of firms (percent) with a positive coefficient ($\beta1$) and significant *t*-statistic	Number of firms (percent) with a positive coefficient (β_1) and insignificant *t*-statistic	Number of firms (percent) with a negative coefficient (β_1) and significant *t*-statistic	Number of firms (percent) with a negative coefficient (β_1) and insignificant *t*-statistic	Sum $\beta_1+\beta_2+\beta_3$	***t_stud***
Quartile 1	10	0.392	0.336	10 (100%)	0 (0%)	0 (0%)	0 (0%)	0.764	1.756
Quartile 2	9	**0.444**	0.445	9 (100%)	0 (0%)	0 (0%)	0 (0%)	**0.905**	7.540
Quartile 3	10	0.441	0.404	10 (100%)	0 (0%)	0 (0%)	0 (0%)	0.831	9.060
Quartile 4	9	0.325	0.321	9 (100%)	0 (0%)	0 (0%)	0 (0%)	0.774	11.439

For the bid-ask spread, the results explicitly demonstrate that the equity securities in the third quartile are more susceptible to commonality in liquidity. However, the sum of the coefficients of market liquidity ($\beta_1 + \beta_2 + \beta_3$) is non-significant, implying that the effect did not persist over time. This finding differs from the findings reported by Chordia et al. (2000) and Pukthuanthong-Le and Visaltanachoti (2009). These prior studies reported that the bid-ask spread of the stocks of large companies is the most sensitive to changes in systematic liquidity. However, our finding is in line with that of Brockman and Chung (2002), who showed that the third quartile is more strongly influenced by the factors of commonality in liquidity. Thus, the two quartiles[6] involving firms with lower market capitalizations are less sensitive to systematic liquidity (0.036 + 0.024 = 0.060), whereas the two last quartiles[7] are more susceptible to liquidity commonality factors (0.123 + 0.102 = 0.225).

For the depth at-best limit, the equity securities in the second quartile are more susceptible to commonality in liquidity. The same result is found in the case of the sum of the market liquidity parameters ($\beta_1 + \beta_2 + \beta_3$). This result indicates that the liquidity of the securities in the second quartile is the most sensitive to an increase in market liquidity. Thus, the quartile with large capitalization securities had the lowest coefficient (β_1) compared to the coefficients in the other quartiles. Our results differ from the results reported by Pukthuanthong-Le and Visaltanachoti (2009) and Brockman and Chung (2002), which showed that the depth at-best limit of the securities of large firms was most susceptible to commonality in liquidity. However, our results are in line with those of Chordia et al. (2000). In fact, we can corroborate our second hypothesis—the effect of market liquidity on the liquidity of securities varies with the size of the listed company. However, it is important to note that the two quartiles involving firms with lower market capitalizations are more sensitive to systematic liquidity (0.392 + 0.444 = 0.836), whereas the last two quartiles are less susceptible to liquidity commonality factors (0.441 + 0.325 = 0.765).

The economic implication of these results is as follows. For investors on the TSEM who hold securities of companies with low market capitalization, we suggest a revision in the quantity they expect to buy and sell accompanied by a relative revision of the bid-ask spread.

3.3 Commonality in Liquidity and Industry Liquidity

We examine the effect of market liquidity on individual liquidity proxies while controlling for the effect of industry liquidity. We explore this effect using the market model proposed by Chordia et al. (2000):

$$L_{j,t} = \alpha_j + \beta_1 L_{M,t} + \beta_2 L_{M,t+1} + \beta_3 L_{M,t-1} + \gamma_1 L_{I,t} + \gamma_2 L_{I,t+1} \\ + \gamma_3 L_{I,t-1} + \delta_1 R_{M,t} + \delta_2 R_{M,t+1} + \delta_3 R_{M,t-1} + \delta_4 R^2{}_{j,t} + \varepsilon_{j,t} \quad (4)$$

where $L_{M,t}$ and $L_{I,t}$ are the weighted cross-sectional average of the liquidity variable for the market and the corresponding industry liquidity of the stock, respectively. We classify all the stocks into four industries, namely, consumer goods, consumer services, financials, and industrials.

Table 4 presents the results of equation 4. For the bid-ask spread, we observe that the coefficient related to the concurrent market-wide liquidity is positive and significant only for 7.89% of the sample. This result highlights the weakness of the positive effect of market liquidity on the liquidity of securities in the case of the TSEM based on the bid-ask spread. The sum of the parameters of market liquidity ($\beta_1 + \beta_2 + \beta_3$) is positive but non-significant significant, implying that market liquidity did not affect the liquidity of securities. In addition, our results show that the explanatory power of the market-wide liquidity variables ($\beta_1 + \beta_2 + \beta_3$) dominates the explanatory power of the industry-wide liquidity variables ($\gamma_1 + \gamma_2 + \gamma_3$). However, contrary to the findings of Chordia et al. (2000), Brockman and Chung (2002), and Pukthuanthong-Le and Visaltanachoti (2009), our evidence reveals that the effect of market liquidity on the liquidity of securities in the Tunisian market is less important compared to the effect in other markets, which are characterized by a very high effect of market liquidity despite controlling for the effect of industry liquidity.

[6] The first two quartiles include firms with the lowest market capitalization.
[7] The last two quartiles include firms with the highest market capitalization.

For industry liquidity, our results show that the parameter γ_1 admits an average value equal to 0.02 (with, t student = 0.088). It is positive for 68.42% of the cases (positive and significant only for 2.63%) and negative and non-significant for 31.58% of the cases. Therefore, we conclude that industry-wide commonality in liquidity is not verified for the Tunisian stock market. This result is contrary to the results reported in Chordia et al. (2000), Brockman and Chung (2002), and Pukthuanthong-Le and Visaltanachoti (2009).

Table 4. Industry-wide and market-wide commonality in liquidity on the Tunisian Stock Exchange

Panel A: Liquidity ≡ Bid-ask Spread

	Market				Industry			
	Concurrent	**Lead**	**Lag**	**Sum**	**Concurrent**	**Lead**	**Lag**	**Sum**
Mean	0.05 [0.77]	0.081 [0.93]	0.069 [0.77]	0.2 [0.11]	0.02 [0.08]	0.01 [0.2]	0.01 [0.17]	0.05 [0.71]
Number of firms (%) with a positive coefficient and non-significant *t*-statistic	32 (84.21%)	28 (73.68%)	25 (65.79%)	23 (60.53%)	26 (65.9%)	24 (63.16%)	22 (57.89%)	14 (36.48%)
Number of firms (%) with a positive coefficient and significant *t*-statistic	3 (7.89%)	6 (15.79%)	5 (13.16%)	12 (31.58%)	1 (2.63%)	4 (10.53%)	3 (7.89%)	6 (15.79%)
Number of firms (%) with a negative coefficient and non-significant *t*-statistic	3 (7.89%)	3 (7.89%)	8 (21.05%)	1 (2.63%)	12 (31.58%)	10 (26.32%)	13 (34.21%)	17 (44.74%)
Number of firms (%) with a negative coefficient and significant *t*-statistic	0 (0%)	1 (2.63%)	0 (0%)	0 (0%)	2 (5.26%)	0 (0%)	1 (2.63%)	1 (2.63%)

Panel B: Liquidity ≡ Depth at-best-limit

	Market				Industry			
	Concurrent	**Lead**	**Lag**	**Sum**	**Concurrent**	**Lead**	**Lag**	**Sum**
Mean	0.365 [3.73]	0.205 [2.21]	0.232 [2.5]	0.802 [6.21]	0.03 [0.39]	-0[-0.1]	-0 [-0.1]	0.01 [2.0]
Number of firms with a positive coefficient (%) and non-significant *t*-statistic	5 (13.16%)	10 (26.32%)	12 (31.58%)	6 (15.79%)	15 (39.47%)	18 (47.37%)	15 (39.47%)	4 (10.53%)
Number of firms (%) with a positive coefficient and significant *t*-statistic	33 (86.84%)	24 (63.16%)	25 (65.79%)	37 (97.37%)	8 (21.05%)	4 (10.53%)	3 (7.89%)	14 (36.48%)
Number of firms(%) with a negative coefficient and non-significant *t*-statistic	0 (0%)	4 (10.53%)	1 (2.63%)	0 (0%)	11 (28.95%)	12 (31.58%)	19 (50%)	10 (26.32%)
Number of firms (%) with a negative coefficient and significant *t*-statistic	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (10.53%)	4 (10.53%)	1 (2.63%)	10 (26.32%)

Notes: [ ] is the value of t statistic.

For the depth at-best limit, the results in Table 4 show that the coefficient (*t_stud*) related to the concurrent market-wide liquidity is 0.365 (3.73). The coefficient is positive and significant for 86.84% of the sample. This empirical evidence implies the existence of commonality in liquidity despite controlling for industry-wide liquidity.[8] In fact, the commonality in liquidity had less effect on the liquidity of securities in the TSEM compared to its effect in a developed market like the NYSE (coefficient β_1 = 0.721), while it had more effect compared to that in the case of emerging markets like SEHK and SET (0.233 and 0.125, respectively).

Thus, the estimated coefficient γ_1 related to industry-wide liquidity has the value 0.03 (with, t statistic = 0.39). This coefficient is positive and significant for 21.05%, and positive and non-significant for 39.47% of the sample. Thus, the results confirm that the industry-wide liquidity effect was lower.

Finally, our result indicates that the explanatory power of market liquidity dominates the explanatory power of industry liquidity in the case of the depth at-best limit. For the sum of the parameters of market liquidity ($\beta_1 + \beta_2 + \beta_3$), our results show that the sum of the coefficients remains positive and significant despite the slight decrease of this value due to the control of industry liquidity. This empirical finding implies that the liquidity of securities is affected by market liquidity over time. Similar to the analysis in the case of the bid-ask spread, Table 5 shows that the coefficient β_1 is positive and statistically significant for 33% of the companies in the financial sector, with an average value of 0.06. Comparing this finding to the empirical evidence demonstrated for the other sectors, we can infer that in the context of the financial sector, the effect of industry liquidity on individual liquidity is important to consumer goods, consumer services, and industrials. This result implies that the securities of the financial industry are more sensitive to market liquidity compared to the securities of the other sectors. This insight is very important for investors in deciding their portfolio investment strategy.

[8] Comparing this result with the empirical evidence in the case of estimated model without the inclusion of industry liquidity, we observe a reduction of the explanatory power of market liquidity, reflected by a decline in the value of coefficient β_1 from 0.401 to 0.365.

Table 5. Market-wide commonality in liquidity by industry on the Tunisian Stock Exchange

	Industry	Number of firms	Coefficient β1 of market liquidity (LM,t)		Number of firms (percent) with a positive coefficient (β1) and significant t-statistic	Number of firms (percent) with a positive coefficient (β1) and insignificant t-statistic	Number of firms (percent) with a negative coefficient (β1) and significant t-statistic	Number of firms (percent) with a negative coefficient (β1) and insignificant t-statistic
			Mean	Median				
Liquidity = Bid-ask Spread	Consumer goods	6	-0.05	-0.55	0.%	50.00%	0%	50%
	Financial	18	0.07	0.52	5.56%	72.22%	0%	22.22%
	Industrial	8	-0.04	-0.35	0%	37.50%	0%	62.50%
	Consumer services	6	0.01	0.04	0%	100%	0%	0%
Liquidity = Depth at-best-limit	Consumer goods	6	-0.03	-0.69	0%	50%	17%	33%
	Financial	18	0.06	0.75	33%	33%	6%	28%
	Industrial	8	0.05	1.21	25%	50%	25%	0%
	Consumer services	6	-0.02	-0.7	0%	33%	33%	33%

3.4 Commonality in Liquidity, Industry Liquidity, and Size Effect

We proved that the effect of commonality in liquidity differs according to the size of the company. Whether this difference remains after controlling for the effect of industry liquidity needs to be explored.

We follow the same strategy of constructing quartiles based on the market capitalization of the companies, and we use the results of equation (4). For the bid-ask spread, the results in Table 6 show that the firms in the third quartile are more susceptible to commonality in bid-ask spread (0.094). We obtain the same sign for the sum of the coefficients of market liquidity ($\beta_1 + \beta_2 + \beta_3$) but non statistically significant. By comparing this result with that when the effect of industry liquidity was not considered, we can deduce that the value of market liquidity decreased from 0.123 to 0.094 in the present case. Therefore, we can conclude that an increase in industry liquidity reduces the explanatory power of systematic liquidity in the third quartile.

The empirical findings in Table 6 reveal that the securities in the first quartile (those with lower market capitalization) are more susceptible to the liquidity commonality of the depth at-best limit. This result is different from the results when the effect of industry liquidity was not considered. However, it is important to note that the quartile with higher market capitalization is characterized by the lowest coefficient β_1 compared to the other quartiles. Thus, we confirm the existence of commonality in liquidity for all the quartiles. The percentage of firms with a positive and significant coefficient is very high for all the four quartiles. We conclude that the increase of commonality in liquidity in the Tunisian stock market obligates the investors holding the securities of companies with low market capitalization to review and revise the expected amounts of purchase and sale relative to the bid-ask spread.

Table 6. Size effect, industry-wide commonality, and market-wide commonality in liquidity on the Tunisian Stock Exchange

Panel A: Liquidity≡Bid-ask Spread

Size of quartile	Number of firms	Coefficient β_1 of market liquidity ($L_{M,t}$)		Number of firms (percent) with a positive coefficient (β1) and significant t-statistic	Number of firms (percent) with a positive coefficient (β1) and insignificant t-statistic	Number of firms (percent) with a negative coefficient (β1) and significant t-statistic	Number of firms (percent) with a negative coefficient (β1) and insignificant t-statistic	Sum	
		Mean	**Median**					**$\beta_1+\beta_2+\beta_3$**	**t_stud**
Quartile 1	10	0.041	0.025	0 (0%)	10 (100%)	0 (0%)	0 (0%)	0.13	-1.168
Quartile 2	9	0.035	0.031	1 (11%)	7 (78%)	0 (0%)	1 (11%)	0.082	0.284
Quartile 3	10	**0.094**	0.054	1 (10%)	9 (90%)	0 (0%)	0 (0%)	0.311	-0.002
Quartile 4	9	0.024	0.035	1 (11%)	6 (67%)	0 (0%)	2 (22%)	0.27	0.545

Panel B: Liquidity≡Depth at-best-limit

Size of quartile	Number of firms	Coefficient β_1 of market liquidity ($L_{M,t}$)		Number of firms (percent) with a positive coefficient (β1) and significant t-statistic	Number of firms (percent) with a positive coefficient (β1) and insignificant t-statistic	Number of firms (percent) with a negative coefficient (β1) and significant t-statistic	Number of firms (percent) with a negative coefficient (β1) and insignificant t-statistic	Sum	
		Mean	**Median**					**$\beta_1+\beta_2+\beta_3$**	**t_stud**
Quartile 1	10	0.433	0.373	10 (100%)	0 (0%)	0 (0%)	0 (0%)	0.866	2.158
Quartile 2	9	0.339	0.343	8 (89%)	0 (0%)	1 (11%)	0 (0%)	0.741	6.063
Quartile 3	10	0.418	0.419	9 (90%)	1 (10%)	0 (0%)	0 (0%)	0.885	7.910
Quartile 4	9	0.259	0.252	6 (67%)	3 (33%)	0 (0%)	0 (0%)	0.699	8.974

3.5 Information Flow and Commonality in Liquidity

In the preceding analysis, we proved the existence of market-wide and industry-wide commonality in liquidity, especially in the case of the depth at-best limit. In this section, we test the existence of market liquidity in the presence of private and public information flow in the entire market. To do this, we propose a modified regression market model:

$$L_{j,t} = \alpha_j + \beta_1 L_{M,t} + \beta_2 L_{M,t+1} + \beta_3 L_{M,t-1} + \theta_1 V_{M,t} + \theta_2 V_{M,t+1} + \theta_3 V_{M,t-1}$$
$$+\varphi_1 OI_{M,t} + \varphi_2 OI_{M,t+1} + \varphi_3 OI_{M,t-1} + \delta_1 R_{M,t} + \delta_2 R_{M,t+1} + \delta_3 R_{M,t-1} + \delta_4 R^2{}_{j,t} + \varepsilon_{j,t} \quad (5)$$

The model proposed in equation 5 differs from the standard market model (equations 4 and 6) by integrating some new variables: the trading volume of the market ($V_{M,t}$) and the order imbalance of the market ($OI_{M,t}$). The terms $V_{M,t+1}$, $V_{M,t-1}$, $OI_{M,t+1}$, and $OI_{M,t-1}$ represent the one-period lead and the lag of the market trading volume, and the one-period lead and lag of the market order imbalance, respectively. In addition, it is very important to note that we exclude the trading volume and order imbalance of individual j when calculating the trading volume and order imbalance of the market. The results of the various estimates of the model (equation 5) are presented in Table 7.

Table 7. Information flow and market-wide commonality in liquidity on TSE

Panel A: Liquidity≡Bid-ask Spread

	Market Bid-ask spread				Systematic trading volume				Systematic order imbalance			
	Concurrent	**Lead**	**Lag**	**Sum**	**Concurrent**	**Lead**	**Lag**	**Sum**	**Concurrent**	**Lead**	**Lag**	**Sum**
Mean	0.063 [0.953]	0.071 [0.939]	0.062 [0.714]	0.196 [1.246]	0.015 [0.686]	0.021 [1.24]	0.011 [0.614]	0.047 [2.865]	0.004 [0.449]	0.003 [0.239]	0 [0.206]	0.007 [0.655]
Number of firms with a positive coefficient and insignificant t-statistic (%)	28 (73.68%)	27 (71.05%)	28 (73.68%)	19 (50%)	25 (65.79%)	17 (44.74%)	14 (36.84%)	7 (18.42%)	20 (52.63%)	17 (44.74%)	17 (44.74%)	15 (39.47
Number of firms with a positive coefficient and t-statistic significant (%)	7 (18.42%)	8 (21.05%)	4 (10.53%)	17 (44.74%)	5 (13.16%)	14 (36.84%)	10 (26.32%)	23 (60.53%)	4 (10.53%)	6 (15.79%)	3 (7.89%)	4 (10.53%)
Number of firms with a negative coefficient and insignificant t-statistic (%)	3 (7.89%)	3 (7.89%)	6 (15.79%)	1 (2.63%)	8 (21.05%)	7 (18.42%)	11 (28.95%)	4 (10.53%)	14 (36.84%)	13 (34.21%)	17 (44.74%)	8 (21.05%)
Number of firms with a negative coefficient and t-statistic significant (%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (2.63%)	0 (0.00%)	0 (0.00%)	4 (10.53%)	4 (10.53%)	0 (0.00%)	2 (5.26%)	1 (2.63%)	11 (28.95%)

Panel B: Liquidity≡Depth at-best-limit

	Market Depth at-best limit				Systematic trading volume				Systematic order imbalance			
	Concurrent	**Lead**	**Lag**	**Sum**	**Concurrent**	**Lead**	**Lag**	**Sum**	**Concurrent**	**Lead**	**Lag**	**Sum**
Mean	0.418 [4.776]	0.212 [2.531]	0.204 [2.537]	0.833 [7.109]	-0.03 [-0.441]	-0.02 [-0.23]	0.041 [0.564]	-0.01 [- 0.052]	0.021 [0.25]	0.014 [0.198]	0.007 [0.118]	0.043 [0.357]
Number of firms with a positive coefficient and insignificant t-statistic (%)	0 (0.00%)	6 (15.79%)	10 (26.32%)	7 (18.42%)	13 (34.21%)	11 (28.95%)	16 (42.11%)	8 (21.05%)	16 (42.11%)	13 (34.21%)	15 (39.47%)	9 (23.68%)
Number of firms with a positive coefficient and t-statistic significant (%)	38 (100.00%)	31 (81.58%)	28 (73.68%)	31 (81.58%)	3 (7.89%)	5 (13.16%)	6 (15.79%)	9 (23.68%)	7 (18.42%)	6 (15.79%)	7 (18.42%)	13 (34.21%)
Number of firms with a negative coefficient and insignificant t-statistic (%)	0 (0.00%)	1 (2.63%)	0 (0.00%)	0 (0.00%)	14 (36.84%)	12 (31.58%)	16 (42.11%)	10 (26.32%)	7 (18.42%)	13 (34.21%)	8 (21.05%)	6 (15.79%)
Number of firms with a negative coefficient and t-statistic significant (%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	8 (21.05%)	10 (26.32%)	0 (0.00%)	11 (28.95%)	8 (21.05%)	6 (15.79%)	8 (21.05%)	10 (26.32%)

For the bid-ask spread, the average coefficient of the concurrent market liquidity variable ($L_{M,t}$) is 0.063, with an associated *t*-statistic of 0.953. The estimated coefficient (β_1) is positive and significant for 18.42% of the firms. With regard to the information variables, the average coefficient of the systematic trading volume is 0.015, and it is not significant. It is significant and positive for 13.16% of the firms. For the coefficient of systematic order imbalance, the average value of this variable is 0.004, and it is not significant. It is positive and significant for 10.53% of the firms. The average of the sum of the market liquidity coefficients ($\beta_1 + \beta_2 + \beta_3$) remains positive[9] but non-significant. In this case, it is important to note that the liquidity of securities did not affected by the market liquidity across time. The empirical results also showed that the average of the sum of the coefficients of systematic trading volume is positive and significant ($\theta_1 + \theta_2 + \theta_3$), while the average of the sum of the coefficients of systematic order imbalance ($\varphi_1 + \varphi_2 + \varphi_3$) is not significant. Similar to the effect of market liquidity, the effect of systematic trading volume persists over time. However, this persistence over time does not appear to be considerable in the case of systematic order imbalance.

For the depth at-best limit, the results show that the average coefficient of the concurrent market liquidity variable ($L_{M,t}$) is 0.418, with an associated *t*-statistic of 4.776. The estimated coefficient (β_1) is positive and significant for the whole sample (100%). For the variables of information, the average coefficient of the systematic trading volume is -0.03, and it is non-significant. It is significant and positive for 7.89% of the sample. For the coefficient of systematic order imbalance, the average value of this variable is 0.021, with an associated *t*-statistic of 0.250. It is positive and significant for 18.42% of the sample. This empirical evidence shows that the effect of the systematic depth at-best limit remains very significant, which confirms that the explanatory power of the liquidity of securities has improved after public and private information flow on the market (the market liquidity coefficient increases from 0.401 to 0.418). In addition, we note that the systematic trading volume leads to a decrease of the liquidity of securities, while the systematic order imbalance leads to an increase of the liquidity. Further, we note that the systematic liquidity dominates systematic trading volume and systematic order imbalance in explaining the liquidity of securities. Moreover, the average of the sum of the coefficients of market liquidity ($\beta_1 + \beta_2 + \beta_3$) remains positive and significant (0.833) with an associated *t*-statistic of 7.109, and it is characterized by a slight decrease generated by the inclusion of the systematic trading volume and systematic order imbalance. In this case, it is important to note that the liquidity of securities is positively and significantly affected by the liquidity of the market. The empirical results also show that the average of the sum of the coefficients of systematic trading volume is negative and insignificant ($\theta_1 + \theta_2 + \theta_3$), while the average of the sum of the coefficients of systematic order imbalance is positive and insignificant ($\varphi_1 + \varphi_2 + \varphi_3$).

Our empirical evidence leads us to conclude that the effect of market liquidity on the liquidity of securities remains positive and significant over time. Earlier, we showed that the effect of systematic trading volume and systematic order imbalance disappears over time.

Finally, our study enriches the literature with a very important conclusion. It is clear that the public and private information flow helps market liquidity to maintain its role in the provision of the liquidity of securities in an order-driven stock market such as the Tunisian market. This information flow leads to a decrease of the explanatory power of the systematic bid-ask spread, and therefore, causes a decrease in the bid-ask spread. Subsequently, it leads to an increase of the explanatory power of the systematic depth at-best limit, and therefore, causes an increase of the depth at-best limit. Thus, we confirm an improvement of liquidity in the Tunisian stock market after information flow.

The economic implication of this result is as follows. This result is important from the perspective of increasing the confidence of local and foreign investors about the potential of the Tunisian stock market. It is especially important for the financial authorities to ensure a higher level of liquidity.

3.6 Information Flow, Commonality in Liquidity, and Size Effect

Table 8 shows that the securities in the third quartile are more susceptible to commonality in the bid-ask spread. The same result is obtained in the case of the sum of the coefficients of market liquidity ($\beta_1 + \beta_2 + \beta_3$). This implies that the bid-ask spread of the securities in the third quartile is more sensitive to an increase in market

[9] It has the value of 0.196, with *t-stud* = 1.246.

liquidity. It is important to note that the third and fourth quartiles—which include the firms with the highest market capitalization—are more influenced by commonality in liquidity (0.098 + 0.097 = 0.194). The other two quartiles (which include firms with a lower market capitalization) are less sensitive to systematic liquidity (0.036 + 0.020 = 0.056).

Table 10 illustrates that the securities in the third quartile are more susceptible to commonality in the depth at-best limit. The same result is found in the case of the sum of the coefficients of market liquidity ($\beta_1 + \beta_2 + \beta_3$). This implies that the depth at-best limit of the securities in the third quartile is more sensitive to an increase in market liquidity all the time. Thus, we find that the quartile of firms with larger capitalization has the lowest coefficient (β_1) compared to the other quartiles.

We conclude that the effect of market liquidity on the liquidity of the securities is not constant but is dependent on the size of the listed company. In addition, we show that the existence of commonality in liquidity on the Tunisian stock market forces investors who hold securities of companies within the third quartile to revise their expected buy and sell quantity, accompanied by a relative change of the bid-ask spread. After the information flow, the Tunisian stock market was found to experience a change in the effect of the market depth at-best limit on the depth at-best limit for the second quartile and the third quartile.

Table 8. Size effect, information flow, and market-wide commonality in liquidity on the Tunisian Stock Exchange

Panel A: Liquidity≡Bid-ask Spread

Size of quartile	Number of firms	Coefficient β_1 of market liquidity ($L_{M,t}$)		Number of firms (percent) with a positive coefficient (β1) and significant t-statistic	Number of firms (percent) with a positive coefficient (β1) andinsignificant t-statistic	Number of firms (percent) with a negative coefficient (β1) and significant t-statistic	Number of firms (percent) with a negative coefficient (β1) and insignificant t-statistic	Sum	
		Mean	**Median**					**$\beta_1+\beta_2+\beta_3$**	**t_stud**
Quartile 1	10	0.036	0.019	1 (10%)	8 (80%)	0(0%)	1 (10%)	0.107	-1.385
Quartile 2	9	0.02	0.021	1 (11.11%)	7 (77.88%)	0(0%)	1 (11.11%)	0.064	-1.320
Quartile 3	10	**0.098**	0.042	1 (10%)	9 (90%)	0(0%)	0 (0%)	**0.323**	-1.883
Quartile 4	9	0.097	0.064	5 (56.56%)	3 (33.33%)	0(0%)	1 (11.11%)	0.285	-.309

Panel B: Liquidity≡Depth at-best-limit

Size of quartile	Number of firms	Coefficient β_1 of market liquidity ($L_{M,t}$)		Number of firms (percent) with a positive coefficient (β1) and significant t-statistic	Number of firms (percent) with a positive coefficient (β1) andinsignificant t-statistic	Number of firms (percent) with a negative coefficient (β1) and significant t-statistic	Number of firms (percent) with a negative coefficient (β1) and insignificant t-statistic	Sum	
		Mean	**Median**					**$\beta_1+\beta_2+\beta_3$**	**t_stud**
Quartile 1	10	0.433	0.418	10 (100%)	0 (0%)	0 (0%)	0 (0%)	0.815	2.059
Quartile 2	9	0.44	0.475	9 (100%)	0 (0%)	0 (0%)	0 (0%)	0.858	6.992
Quartile 3	10	**0.443**	0.415	10 (100%)	0 (0%)	0 (0%)	0 (0%)	0.868	8.797
Quartile 4	9	0.35	0.293	9 (100%)	0 (0%)	0 (0%)	0 (0%)	0.791	10.960

3.7 Commonality in Liquidity, Industry Liquidity, and Information Flow

Prior studies on commonality in liquidity did not pay much attention to the role of information flows on the relationship between market liquidity and liquidity of securities. The conclusion drawn in the previous section remains insufficient since the effect of the industry liquidity was not taken into account. Therefore, we examine the effect of industry liquidity and market liquidity on the liquidity of securities in the presence of the public and private information flows in the Tunisian stock market. This effect will be explored through the methodological approach proposed by Chordia et al. (2000). The general form of the model is tested as follows:

$$L_{j,t} = \alpha_j + \beta_1 L_{M,t} + \beta_2 L_{M,t+1} + \beta_3 L_{M,t-1} + \gamma_1 L_{I,t} + \gamma_2 L_{I,t+1} + \gamma_3 L_{I,t-1} + \theta_1 V_{M,t} + \theta_2 V_{M,t+1} + \theta_3 V_{M,t-1} + \varphi_1 OI_{M,t} + \varphi_2 OI_{M,t+1} + \varphi_3 OI_{M,t-1} + \delta_1 R_{M,t} + \delta_2 R_{M,t+1} + \delta_3 R_{M,t-1} + \delta_4 R^2{}_{j,t} + \varepsilon_{j,t} \quad (6)$$

In addition to the main explanatory variables in the model (equation 4), our new model integrates the trading volume of the market ($V_{M,t}$) and the order imbalance of the market($OI_{M,t}$). The terms $V_{M,t+1}$, $V_{M,t-1}$, $OI_{M,t+1}$, and $OI_{M,t-1}$ are the one-period lead and lag of the trading volume of the market, and the one-period lead and lag of the order imbalance of the market, respectively. In addition, it is very important to note that the trading volume and order imbalance of individual j are excluded when calculating the trading volume of the market and the order imbalance of the market. The results of the various estimates of the model (equation 6) are presented in Table 9. Several conclusions can be drawn from Table 9.

For the bid-ask spread, the average coefficient of the concurrent market liquidity variable ($L_{M,t}$) is 0.043, with an associated *t*-statistic of 0.706. This result rejects the hypothesis that market liquidity has an impact on the liquidity of securities.

For the coefficient γ_1 related to industry liquidity, we find that this parameter has an average value of 0.016 and is non-significant. Thus, we can summarize that the bid-ask spread of the security is not significantly influenced by market liquidity and industry liquidity at time *t*. Similarly, when we reason in terms of time, it is clear also that the effect of market liquidity is non-significant. In this case, the information flow is a guarantee that systematic liquidity will maintain its role in explaining the liquidity of securities. In addition, this finding indicates that the explanatory power of market liquidity dominates that of the industry liquidity in the case of the bid-ask spread.

For the variables of information, the average coefficient of the systematic trading volume is insignificant (*t*-statistic equal to 0.656), with a value equal to 0.015. It is positive for 76.32% of the sample (13.16% of these firms had a positive and significant coefficient), while 23.68% are negative and insignificant. The average value of the coefficient of systematic order imbalance is 0.003, and it is non-significant (*t*-statistic equal to 0.445). It is positive for 63.16% of the sample (10.53% of these firms had a positive and significant coefficient), while 36.84% of the cases are negative and non-significant. This result shows that there is a positive relationship involving the systematic trading volume, the imbalance of systematic order, and the industry bid-ask spread. However, this association is characterized by a relative significance. In addition, the reasoning in terms of the sum of the coefficients of the systematic trading volume ($\theta_1 + \theta_2 + \theta_3$) and systematic order imbalance ($\varphi_1 + \varphi_2 + \varphi_3$) produces a different pattern from what was shown previously in this section.

The average value of the sum of all the coefficients of the systematic trading volume is 0.045 and non-significant (t statistic = 0.06), while the average value of the sum of the all coefficients of the systematic order imbalance is 0.006 and significant (t statistic = 2.725). Thus, we confirm the existence of the effect of systematic trading volume that persists over time. The effect of systematic order imbalance has an impact on the security liquidity; however, this effect is not significant over time. Thus, the hypothesis related to the existence of a positive relationship between information flow and the liquidity of securities is partially supported. In another phase of analysis, Table 9 shows the importance of the effect of commonality in liquidity by industry.

For the depth at-best limit, the value of the average coefficient (β_1) related to the main explanatory variable ($L_{M,t}$) is 0.369, with an associated *t*-statistic of 3.459. The estimated parameter is positive and significant for a large proportion of our sample (86.84%). This empirical evidence supports the existence of commonality in liquidity in the Tunisian stock market, despite controlling for the effect of industry liquidity and that of information flow. By comparing this finding with that for the model without systematic trading volume and systematic order imbalance, we see that an improvement of the explanatory power of market liquidity resulted in an increase of the value coefficient (β_1) from 0.365 to a value of 0.369. However, when we focus on the effect of the full coefficients of market liquidity ($\beta_1 + \beta_2 + \beta_3$), we find that the sum of these coefficients remains positive, and it is significant in explaining the increase due to the inclusion of the effect of industry liquidity, the systematic trading volume, and systematic order imbalance. In this case, the liquidity of securities is positively and significantly affected by the market liquidity that persists over time.

Table 9. Information flow, Industry-wide and market-wide commonality in liquidity on TSE

Panel A: Liquidity≡Bid-ask Spread

	Market Bid-ask spread				Industry Depth at-best limit			
	Concurrent	**Lead**	**Lag**	**Sum**	**Concurrent**	**Lead**	**Lag**	**Sum**
Mean	0.043 [0.706]	0.066 [0.738]	0.055 [0.605]	0.165 [-1.156]	0.016 [0.058]	0.008 [0.167]	0.009 [0.098]	0.033[0.491]
Number of firms with a positive coefficient and insignificant t-statistic (%)	32 (84.21%)	30 (78.95%)	22 (57.89%)	21 (55.26%)	21 (55.26%)	17 (44.74%)	17 (44.74%)	5 (13.16%)
Number of firms with a positive coefficient and t-statistic significant (%)	3 (7.89%)	3 (7.89%)	5 (13.16%)	14 (36.84%)	0 (0%)	3 (7.89%)	2 (5.26%)	14 (36.48%)
Number of firms with a negative coefficient and insignificant t-statistic (%)	3 (7.89%)	4 (10.53%)	11 (28.95%)	1 (2.63%)	17 (17%)	18 (47.37%)	17 (44.74%)	11 (28.95%)
Number of firms with a negative coefficient and t-statistic significant(%)	0 (0%)	1 (2.63%)	0 (0%)	2 (5.26%)	0 (0%)	0 (0%)	2 (5.26%)	8 (21.05%)

Panel A: Liquidity≡Bid-ask Spread (continued)

	Systematic trading volume				Systematic order imbalance			
	Concurrent	**Lead**	**Lag**	**Sum**	**Concurrent**	**Lead**	**Lag**	**Sum**
Mean	0.015 [0.656]	0.02 [1.196]	0.01 [0.579]	0.045 [0.688]	0.003 [0.445]	0.002 [0.227]	0.001 [0.208]	0.006 [2.725]
Number of firms with a positive coefficient and insignificant t-statistic (%)	24 (63.16%)	18 (47.37%)	14 (36.84%)	18 (47.37%)	20 (52.63%)	17 (44.74%)	18 (47.37%)	7(18.42%)
Number of firms with a positive coefficient and t-statistic significant (%)	5 (13.16%)	13 (34.21%)	10 (26.32%)	10 (26.32%)	4 (10.53%)	6 (15.79%)	2 (5.26%)	18 (47.37%)
Number of firms with a negative coefficient and insignificant t-statistic (%)	9 (23.68%)	7 (18.42%)	11 (28.95%)	7(18.42%)	14 (36.84%)	11 (28.95%)	17 (44.74%)	3 (7.89%)
Number of firms with a negative coefficient and t-statistic significant(%)	0 (0%)	0 (0%)	3 (7.89%)	3 (7.89%)	0 (0%)	4 (10.53%)	1 (2.63%)	10 (26.32%)

(Table 9 continued)

Panel B: Liquidity≡Depth at-best-limit

	Market Depth at-best limit				Industry Depth at-best limit			
	Concurrent	**Lead**	**Lag**	**Sum**	**Concurrent**	**Lead**	**Lag**	**Sum**
Mean	0.369 [3.459]	0.224 [2.099]	0.215 [2.085]	0.808 [6.066]	0.035 [0.403]	-0.011 [-0.087]	-0.011 [-0.061]	0.013 [0.164]
Number of firms with a positive coefficient and insignificant t-statistic (%)	3 (7.89%)	10 (26.32%)	11 (28.95%)	6 (15.79%)	15 (39.47%)	20 (52.63%)	13 (34.21%)	8 (21.05%)
Number of firms with a positive coefficient and t-statistic significant (%)	33 (86.84%)	26 (68.42%)	25 (65.79%)	31 (81.58%)	8 (21.05%)	4 (10.53%)	5 (13.16%)	10 (26.32%)
Number of firms with a negative coefficient and insignificant t-statistic (%)	2 (5.26%)	2 (5.26%)	2 (5.26%)	0 (0%)	11 (28.95%)	14 (36.84%)	13 (34.21%)	12 (31.58%)
Number of firms with a negative coefficient and t-statistic significant (%)	0 (0%)	0 (0%)	0 (0%)	1 (2.63%)	4 (10.53%)	4 (10.53%)	7 (18.42%)	8 (21.05%)

Panel B: Liquidity≡Depth at-best-limit (continued)

	Systematic trading volume				Systematic order imbalance			
	Concurrent	**Lead**	**Lag**	**Sum**	**Concurrent**	**Lead**	**Lag**	**Sum**
Mean	-0.035 [-0.444]	-0.023 [-0.257]	0.039 [0.539]	-0.019 [0.351]	0.019 [0.219]	0.011 [0.159]	0.006 [0.102]	0.036 [-0.148]
Number of firms with a positive coefficient and insignificant t-statistic (%)	13 (34.21%)	12 (34.21%)	17 (44.74%)	16 (42.11%)	15 (39.47%)	14 (36.84%)	14 (36.84%)	11 (28.95%)
Number of firms with a positive coefficient and t-statistic significant (%)	3 (7.89%)	5 (13.16%)	6 (15.79%)	1 (2.63%)	8 (21.05%)	6 (15.79%)	7 (18.42%)	11 (28.95%)
Number of firms with a negative coefficient and insignificant t-statistic (%)	14 (36.84%)	12 (31.58%)	15 (39.47%)	19 (50%)	7 (18.42%)	11 (28.95%)	9 (23.68%)	7 (18.42%)
Number of firms with a negative coefficient and t-statistic significant (%)	8 (21.05%)	9 (23.68%)	0 (0%)	2 (5.26%)	8 (21.05%)	7 (18.42%)	8 (21.05%)	(23.68%)

For the coefficient γ_1 related to the variable of industry liquidity ($L_{I,t}$), we find that the parameter γ_1 has an average value of 0.035 but is non-significant. Thus, we can summarize that the security depth at-best limit is significantly influenced by the market liquidity; however, it is less influenced by industry liquidity. For the variables of the information flow, the average coefficient for the systematic trading volume is -0.035, with an associated *t*-statistic of -0.444. It is positive for 42.11% of the sample, and 7.89% of these firms are positive and significant. In contrast, it is negative for 57.89% of the cases, and 21.05% of these firms are negative and significant. For the coefficient of systematic order imbalance, the average value of this variable is 0.019, with an associated *t*-statistic of 0.219. It is positive for 60.53% of the cases, including 21.05% cases that are positive and significant, while it is negative for 39.47% of the cases, of which 21.05% are negative and significant. These results show that the relationship involving systematic trading volume, systematic order imbalance, and the security depth at-best limit is ambiguous since the effect of the trading volume is characterized by negativity and insignificance, whereas the effect of order imbalance is characterized by positivity and insignificance.

4. CONCLUSION

A significant challenge faced by Tunisian financial authorities is to attract financial investors in order to promote the development of their financial market. This objective can be reached only if we have an in-depth understanding of the dynamics of liquidity over time, which will help to avoid liquidity risk. More specifically, analyzing the Tunisian commonality in liquidity may provide important insights for investors, regulators, and central banking authority. The Tunisian context was studied for the first time in this research. We complemented the literature on commonality in liquidity by proposing new hypotheses (e.g., the influence of commonality in liquidity on the liquidity of securities varies in the presence of the effect of public and private information). To test these hypotheses, we used the approach proposed by Chordia et al. (2000) based on a market model adapted to liquidity. We considered a database that contains intraday observations from the Tunisian stock market during the period October 2008 to June 2009.

Our analysis highlights many findings. Firstly, we prove that market liquidity is a major determinant of the liquidity in the Tunisian stock market. Secondly, we show that the effect of market liquidity on the liquidity of securities is more pronounced in the case of the depth at-best limit than in the case of the bid-ask spread. Thirdly, we note that the systematic liquidity detected in an order-driven market has less effect than was seen in a quote-driven market. Fourthly, the analysis of the relationship between size effect and commonality in liquidity showed that the securities of the third quartile are more susceptible to the bid-ask spread of the market, while the securities of the second quartile are sensitive to the depth at-best limit of the market. This finding coincides with the empirical evidence developed in the earlier literature that the effect of commonality in liquidity on the liquidity of the security varies with the size of the listed firm. Moreover, we showed that the effect of industry liquidity on the liquidity of securities in the Tunisian market—in the case of the bid-ask spread as well as the depth at-best limit—is positive. Finally, we prove that the public and private information flows lead to an improvement of liquidity in the Tunisian market.

More specifically, the inclusion of systematic trading volume and systematic order imbalance led to a decrease of the explanatory power of market liquidity in the case of the bid-ask spread, while it led to an increase of the explanatory power in the case of the depth at-best limit. Further, systematic trading volume dominates systematic order imbalance in explaining liquidity. However, this effect is less significant compared to that of market liquidity.

Our findings are important for academics, regulators, and investors. First, the study of the commonality in liquidity in emerging markets such as the Tunisian stock market is important for understanding the process of price formation and liquidity. Second, in addition to the specific determinants related to the security, there are systematic market and industry factors that affect liquidity. Understanding the factors affecting liquidity would increase the level of confidence among investors by helping them to understand the functioning of the market. Finally, the existence of systematic liquidity in the Tunisian market is important because it obligates the financial authorities to take steps to avoid the danger of the sudden evaporation of liquidity.

The current study has a number of limitations that should be taken into account in the future studies in this area. First, we must extend our analysis selected MENA countries that are not treated in the literature. Second, an interesting subject for future research consists to study the commonality in liquidity in the wake of the Jasmine revolution for the case of Tunisia and Egypt.

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