The estimation in (10) by OLS method (Note that all measures of liquidity are stationary). clears a Durbin-Watson value near to unit for all measures of liquidity. This implies the existence of positive auto-correlations in innovations. These auto-correlations are in order 1(We used an econometric method that consists in adding to the regression (5), AR(1) AR(2)…then we tested the significant power of the auto-correlations coefficients . The result proves that only the coefficients of order 1 are significant) for all stocks liquidity measures in our sample.

To solve this problem of auto-correlations in innovations, we estimate model (11), while using the Eviews 6 Software that permits to estimate by OLS method the auto-correlation coefficients:

$$L_{i,t} = \beta_{0,i} + \beta_{m,i} L_{m,t} + \rho \mu_{t-1} + \nu_t \quad (11)$$

ρ, *are* the auto-correlation coefficients in innovations between dates t and t-1.

Results of the estimation of market model in (11) are very powerful. Indeed, all coefficients are positive, but 11% are only not significant. This proves that the individual stock liquidity was strongly correlated with aggregated market liquidity, what again reinforces the hypothesis of the validation of a market model adapted to different liquidity measures on Tunisian stock market.

It is to note that, the explanatory power of this last model is not important. Indeed, the average determination coefficients for the different measures of the liquidity are 18% for the quoted depth, 28% for the quoted spread, 25% for the effective spread and 29.4% for the lambda. This is can be justified by the existence of noise or that it exists other factors can influenced individual stocks liquidity.

5.3. Empirical studies on individual determinants of the liquidity on the Tunisian stock market

In the literature of market microstructure many study reinforces the hypothesis according to which the liquidity is conditioned by the strategic indicators measuring the performance of market, among these factors we distinguish: trading volume, number of trades, return, volatility and lag variable of liquidity measure, etc.

5.3.1. Trading volume

The effect of trading volume on the spread is ambivalent. Trading volume is carrier of news that market maker ignored; in this case, he enlarges his spread to hedge his position. However, by reason of the competition, he could be obliged to reduce spread and play on the volume. With regard to the effect of trading volume on the depth, the different studies detected a positive relation.

To study the relation between liquidity and trading volume (measured in number of stocks exchanged), we estimate equation (12):

$$L_{i,t} = a_0 + a_1 V_{i,t} + u_{i,t} \quad (12)$$

$V_{i,t}$, *is the logarithm of trading volume for stocks at the time t.*

To estimate this equation we use Panel data for 40 stocks quoted in continuous and most active on the Tunisian stock market on the period going from February 07, 2011 to January 31, 2013, either 104 weekly observations for each stock. Therefore, in whole, we have 4160 observations for each variable.

Estimation of equation (12) by the OLS method [It is to note that the trading volume expressed in logarithm is stationary. In the same way, all other variables that we are going to use are thereafter are stationary, except variable «price (P)" that is stationary in difference (DS)] proves the existence of positive auto-correlations in innovations (Durbin-Watson near of 1). To solve this problem we estimate, rather, equation (13):

$$L_{i,t} = a_0 + a_1 V_{i,t} + \rho\, u_{i,t-1} + \varepsilon_{i,t} \quad (13)$$

Results of estimation are very powerful and reject the hypothesis of an ambivalent relationship between liquidity and trading volume. Indeed, we detect a negative and significant relationship between the different illiquidity measures (quoted spread, proportional effective spread and lambda) and the trading volume. Besides, we detect a positive and significant relation between depth and trading volume with a t-student of 6.2. This positive and significant relation between liquidity and trading volume on the Tunisian stock market confirms the strategic behaviour of operators that chooses to negotiate just when stocks become very liquid (narrow spread and elevated depth).

5.3.2 Number of trades

In order to study the link between liquidity and number of trades we estimate, using data Panel, by the OLS method equation (14):

$$L_{i,t} = b_0 + b_1 N_{i,t} + \nu_{i,t} \quad (14)$$

$N_{i,t}$, is the logarithm of number of trades for stocks i at a date t.

To solve the problem of mistake auto-correlation in innovations, we estimate rather equation (15):

$$L_{i,t} = b_0 + b_1 N_{i,t} + \rho\, \nu_{i,t-1} + \eta_{i,t} \quad (15)$$

Results of estimation show an ambiguousness relationship between liquidity and number of trades. On the one hand, we observe a negative and significant relation between illiquidity measures and number of trades. On the other hand, we observe a negative and significant relationship between depth and number of trades. The existence of a negative relation between the depth and number of trades can be explained by the tendency of intermediaries in stock market to exercise some trading in block because the Tunisian stock market lacks of informed traders.

5.3.3 Return

In our empirical investigation we estimate by OLS method equation (16):

$$L_{i,t} = c_0 + c_1 R_{i,t} + \rho v_{i,t-1} + \eta_{i,t} \quad (16)$$

$R_{i,t}$ = Log (P_t / P_{t-1}), is the return for stock i, at a week t.

Estimation results document a positive and significant relationship (but insignificant, solely, for the quoted spread) between return and stocks liquidity. Indeed, we observe, on the one hand, some negative coefficients for the different illiquidity measures; it is of - 0.013 with a t-student of - 0.64 for the quoted spread, - 0.045 with a t-student of - 4.54 for the proportional effective spread and of - 0.006 with a t-student of - 2.17 for the lambda. On the other hand, we detect positive and significant coefficients between the quoted depth and return. this is in contradiction with the result of Amihud & Mendelson (1986) and Brennan, Chordia & Subrahmanyam that recommend that liquid stocks procure to their holding weak return. This positive relation between liquidity and return on the Tunisian market can be explained by the tendency of intermediaries in stock market to negotiate stocks that procure the most elevated returns.

5.3.4 Volatility

By reason of the absence of a sufficient number of quotations inside the week to calculate prices volatility, we use an approach that consists to estimate the volatility from the past prices. There is little evidence that stock market varies systematically with time. There is also strong evidence that ARCH models (Autoregressive Conditional Heteroskedasticity; Engel, 1982) are good descriptions of time-varying volatility in stock prices. Review article such Bollerslev (1986) documents the effective application of ARCH(p) and GARCH(p,q) (General Autoregressive Conditional Heteroskedasticity) models to financial time series across a wide variety of markets.

In our investigation we use GARCH (1.1) model to estimate volatility:

$$\begin{cases} Log(P_t) = \alpha_0 + \alpha_1 Log(P_{t-1}) + u_t & (a) \\ h_t = a_0 + a_1 u_{t-1}^2 + a_2 h_{t-1} & (b) \end{cases} \quad (17)$$

In equation (17. a), $\alpha_0 = E[Log(P_t \setminus F_{t-1})]$ is the conditional average of information in t-1 represented by the whole F_{t-1} and u_t designates the shock.

In equation (17. b), $h_t = E_{t-1}(u_t^2 \setminus F_{t-1})$ is the conditional variance to F_{t-1}. By definition, it is the expected component of the volatility. The equation (b) is a modelling of this component that is then function of the passed innovations u_{t-1} (a_1 is interpreted as the size of this shock) and of the passed volatility h_{t-1} (a_2 is an indicator of pers istence).

To estimate the volatility by the GARCH (1, 1) model, we, first, examine the distributions of stocks prices using the Eviews 6software. We notice that these distributions depart of the normal distribution as indicated by tests of skewness and kurtosis. The test of skewness rejects significantly the symmetry (H_0: sk = 0) with an average value of 0.63. The test of kurtosis rejects the hypothesis of a normal distribution (ku =3) with a value of 2.13. Besides, the statistical of Jarque-Bera $JB = ((N-h)/6) * \left[S^2 + 1/4(K-3)^2\right]$. (Where, S is the skewness, K is the kurtosis, h is the number of parameters to estimate and N design the number of observations) is 8.05 with a near probability of zero. Therefore, we reject the hypothesis of a normal distribution of the stocks prices.

The estimation of equation (a) by the OLS method puts a problem of a unit root for all stocks in our sample. The Dickey-Fuller test indicates that distributions are deference stationary (DS). Therefore, we estimate for every stock, the following model by the ARCH method:

$$DLog(P_t) = a_0 + u_t \quad (18)$$

Once this last model is estimated, using the ARCH estimation method with Eviews 6 software, we generates for every stock the data of the volatility h_{t-1} .

$$h_t = a_0 + a_1 \mu_{t-1}^2 + a_2 h_{t-1} \quad (19)$$

Estimation results of model (19) indicate that current volatility depends of lagged volatility h_{t-1} (GARCH), whose coefficient a_2 is positive and significant for most stocks. Besides, the results suggest that current volatility depends of lagged squared innovations, u_{t-1}^2 (ARCH), whose coefficient a_1 is positive and significant.

Once, the volatility is estimated, we examine their influence on the liquidity. Therefore, it is necessary to estimate the following model while using Panel data (It is to notice that we lost for every stock the first observation. To the whole, we lost 40 observations for each variable; therefore we dispose of 4160 observations)

$$L_{i,t} = d_0 + d_1 h_{i,t} + \rho w_{i,t-1} + \psi_{i,t} \quad (20)$$

Estimation results in equation (20) show, on the one hand, that volatility is positively related to spreads (quoted spread and lambda). This can essentially be explained by the strategic behaviour of traders that choose to widen spread to compensate the risk of a strong prices volatility in them disfavour. On the other hand, results show a negative relationship, but not significant, between depth and volatility. This shows the absence of a strong relationship between liquidity and volatility on the Tunisian stock market.

5.3.5 Past information

To judge the influence of the past information on the stocks liquidity, we introduced a lagged variable because liquidity at time t-1 has an influence on the liquidity at time t. This influence is essentially owed to the incorporation in prices and volumes that are attached to information revealed by the past transactions. Some supplementary lags don't contribute to increase the explanatory power of the model. Therefore, liquidity follows an auto-regressive process of order 1.

$$L_{i,t} = e_0 + e_1 L_{i,t-1} + \gamma_{i,t} \quad (21)$$

Using Panel data, estimation results make appear that past liquidity contributes strongly to explain current liquidity. Indeed, coefficients of the past liquidity are positive and significant for all liquidity measures. This shows the importance of the past information to explain the behaviour of liquidity of stocks quoted in continuous.

5.4. Determinants of the common movements in liquidity on the Tunisian stock market

To examine the hypothesis of the presence of common factors in liquidity, we based on previous results indicated that the trading volume, return and lagged liquidity measures contribute significantly to explain the behaviour of liquidity measures of all stocks quoted in continuous on the Tunisian stock market. Therefore we are going to examine if these variables can be considered as common factors in liquidity.

Therefore, we estimate, using panel data for each group, the following regression (pooled cross-section time series):

$$L_{i,t} = c_{i,t} + \alpha_i V_{i,t} + \beta_i R_{i,t} + \chi_i L_{i,t-1.} + \varepsilon_{i,t}$$

(22)

$L_{i,t}$ et $L_{i,t-1}$ are the liquidity measures for stock i at the weeks t and t-1.

$V_{i,t}$, is the logarithm of trading volume for stocks at a week t.

$R_{i,t} = Log (P_t / P_{t-1})$, is the return for stock i, at a week t.

In tables 2 we report estimates coefficients for the regressions of our four liquidity proxies on the explanatory variables.

Table 2: Determinants of the common movements in liquidity

PANEL		C	V	R	S(-1)	***R*** ^{2}
S		0.017485	-0.001276	-0.026352	0.254798	**0.129083**
	t-st	(5.502999)*	(-4.221660)	(-0.652348)	(5.456235)	
SP		0.005576	-0.000432	-0.0756348	0.328254	**0.219406**
	t-st	(6.893580)*	(-3.796875)	(-3.65234)	(7.489629)	
DE		2.712189	-0.045168	30.79190	0.488769	**0.318134**
	t-st	(3.276671)*	(-1.135465)	(5.6542387)	(13.00661)	
SE		0.001559	-0.000146	-0.010545	0.374519	**0.255791**
	t-st	(5.082276)*	(-4.906551)	(-2.101210)	(8.489462)	

- *Trading volume:* Table 2 shows that trading volume is negatively and significantly correlated to the different measures of illiquidity. However, the depth is negatively correlated with trading volume, but this relationship is not significant (t-student of -1.13).
- *Return:* Table 2 reveals that return is negatively correlated to the quoted spread (with a t-student of -*0.652348*), to the proportional effective spread (with a t-student of -*3.65*) and to the lambda (with a t-student of -2.10). Besides, return is positively and significantly correlated to the quoted depth (with a t-student of *5.65*).
- Past information: Tables 2 indicates that, even if we account for volume, return, the past information (represented by the lagged liquidity variable) remains a strategically variable that contributes strongly and significantly to explain the behaviour of the different liquidity measures of stocks.

Thus, our results contradict the hypothesis that volume and return contribute strongly to explain the behaviour of the liquidity. Therefore, volume and return don't constitute a common factor for the different liquidity measures of the stocks quoted in continuous on the Tunisian stock market. In opposite, we can consider, probably, the past information as a common factor for the different liquidity measures for all stocks in our sample quoted in continuous on the Tunisian stock market.

6. Conclusion

Literature of market microstructure proposed a diversity of measures, such as: the quoted spread, proportional effective spread, lambda, quoted depth … In the goal to judge the validity of these measures on the Tunisian stock market, we tried to verify the hypothesis that different illiquidity measures (quoted spread, proportional effective spread, lambda) vary in inverse sense with the quoted depth. Our survey led on 40 stocks quoted in continuous reinforces this last hypothesis for the individual stocks as well as for the whole of the market.

The main goal of this paper was to test empirically the hypothesis of the presence of variables influencing liquidity stocks quoted in continuous on the Tunisian stock market.

The most important empirical results find that:

- It exist a "market model" for liquidity.
- Trading volume has positive and significant relationship with the stocks liquidity.
- It exist ambiguousness as for the influence of the number of trades on stocks liquidity.
- Return is positively and significantly correlated with stocks liquidity.
- Relationship between liquidity and the volatility is not significant.
- Liquidity is auto-regressive of order 1. Indeed, the lagged liquidity has strong contribution to explain the current liquidity.

So, we can consider, probably, the past information as a common factor for the different liquidity measures for all stocks in our sample quoted in continuous on the Tunisian stock market.

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