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Review Article

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An Examination of the Relationship between Volatility, Liquidity and Trading Activity

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Abstract

We investigate the influence of the firm value on the relationship between equity trading activity, market liquidity and return volatility at the portfolio level. For the different firmvalue portfolio, we find that trading activity is negatively associated with liquidity but it is positively associated with volatility so higher trading activity leads to more volatile returns. For the very largest firm-value portfolio, the volatility-liquidity relationship is negative. However, this relationship is positive for other portfolios.

Keywords: Liquidity, Volatility, Trading Activity, Tunis Stock Exchange

1. Introduction

Since the global financial crisis of 2008, a broader understanding of the dynamics of market liquidity has become one of the most urgent priorities facing regulators in developed economies. Market microstructure theories predict a negative relationship between security liquidity and volatility. Although this relationship is evident for individual securities, at a portfolio level the picture is not clear [1,2].

Most theoretical research places asset risk as the main determinant of liquidity in financial markets. In this paper, we empirically explore this linkage at the portfolio level to better understand how general market behavior is framed by liquidity and volatility. A portfolio level analysis is important in the context of the proliferation of broad index-based investment portfolios in existence today.

Inventory models of liquidity predict a negative relation between asset volatility and liquidity [3-9]. However, information-based models of liquidity predict that the relationship between liquidity and volatility can be either positive or negative. Admati and Pfleiderer and Barclay and Warner show that informed stealth trading amidst a larger group of uninformed liquidity traders can lead to a positive relationship between volatility and liquidity [10,11]. On the other hand, Foster and Viswanathan suggest that specialists' knowledge of the presence of informed traders can result in a negative relationship between volatility and liquidity [9]. Empirical evidence is similarly mixed. Tinic, Stoll and Menyah and Paudyal, all report a positive relationship between volatility and liquidity [4,12-14]. Pastor and Stambaugh find that the empirical correlation between aggregate liquidity and market volatility is negative, and Chordia et al. document a positive relation between aggregate volatility and liquidity [2,15].

This paper makes several new and unique contributions to the literature. First, while most research focuses on the security-level liquidity-volatility relationship, we consider the relationship on a portfolio basis. Second, we look at how market volatility impacts upon liquidity. Third, we acknowledge the limiting issues of multicollinearity among market variables. In addition to exploring the aggregate liquidity-volatility relation, we also investigate the influential factors that may accentuate the role of volatility on market liquidity. Trading volume is one such factor that can influence the volatility-liquidity relation.

Barclay and Warner Jones et al. (1994), Huang and Masulis and Darrat et al. show that trading volume covaries with volatility at the firm level [11,16-18]. In addition, trading volume is regarded as one of the more influential determinants of a security's bid-ask spread [4,13,14,19]. Subrahmanyam Foster and Viswanathan and Nelling and Goldstein show that competition among market makers, volume of liquidity motivated transactions, and the quality of public information a firm disseminates are also important determinants of spread [9,20,21]. Those determinants are proxied to a large extent by the size of the firm. Thus, the study also investigates the role of the firm value (capitalization) on the liquidity volatility relationship.

2. Data and Methodology

The data employed in the study are the daily bid-ask spread, realized volatility, number of transactions and trading volume of 20 firms listed on the Tunis Stock Exchange from 04 January, 2010 to 31 December, 2015. The bid-ask spread (BAS) is used to proxy the market-liquidity, while the number of transactions

(NT) and trading volume (VO) are used as measures of trading activity. The aggregate liquidity and trading activity variables are constructed by taking the simple average of the variables across companies for each portfolio and for all companies.

The market volatility variable, STDEV, is calculated as the standard deviation of daily return r_t, which is calculated as the continuously compounded return using the closing price:

$r_t = \ln(p_t) - \ln(p_{t-1})$

Where $\ln(p_t)$ denotes the natural logarithm of the closing price at time t.

This study employs the total risk measure instead of the systematic and/or residual risk. In the literature, there is a debate on which risk measure is more appropriate measure. Benston and Hagerman argue that only the residual (unsystematic) risk should be considered [22].

However, Stoll argues that the market-making process makes dealers unable to maintain either diversified portfolios or the ones suitable for their risk-return preferences [4].

Therefore, it should be the total (both systematic and residual) risk that matters than the residual risk alone. The empirical evidence by Stoll and Menyah and paudyal from the US and the UK, respectively, strongly supports the importance of total risk in the spread-setting behaviour of dealers [4,14].

Our regression model is estimated using Hansen's Generalized Method of moments (GMM) technique with the Newey and west correction for serial correlation [23,24]. GMM estimates are robust to the presence of autocorrelation and heteroscedasticity, both of which one would except to find in this type of data. Since the system is just identified, the GMM coefficient estimates are identical to those from OLS, although their standard errors are different.

3. Results

3.1 Preliminary Analysis

The analysis consists of four main variables: bid-ask spread (BAS), the daily return standard deviation (STDEV), the number of trades (NT), and the trading volume (VOL).

	BAS	STDEV	NT	VOL
mean	1.480828	0.010837	3.093799	8.286531
median	0.476500	0.009768	3.067628	8.276103
maximum	6.329000	0.138250	4.728940	10.29213
minimum	0.076500	0.000000	1.550553	6.154829
S.D	1.760679	0.007290	0.509901	0.658984
Skewness	1.323907	10.03521	0.244697	0.050570
Excess Kurtosis	3.411209	149.9730	2.899804	2.892639

Table 1: Descriptive Statistics

	BAS	NT	STDEV	VOL
BAS	1	0.42782	0.01307	0.28709
NT		1	0.134937	0.93410
STDEV			1	0.10960
VOL				1

Table 2: Correlation Matrix

Table 1 presents the descriptive statistics and table 2 presents the correlation matrix. It is clear that the interrelationship between the components of trading activity (NT and VOL) is strong. However, it is low between other variables.

Since our econometric methodology utilises Generalised Method of Moments (GMM), we test to see if our variables meet the assumptions required for GMM estimation. The most important assumption is that the variables are stationary. For this purpose, we carry out the Augmented Dickey and Fuller unit root test.

	BAS	NT	STDEV	VOL
	ADF p-value	ADF p-value	ADF p-value	ADF p-value
All companies	-25.034 0.000	-5.605 0.000	-15.973 0.000	-6.499 0.000
P1	-25.220 0.000	-5.652 0.000	-21.077 0.000	-5.689 0.000
P2	-23.734 0.000	-6.869 0.000	-16.620 0.000	-8.702 0.000

P3	-28.734 0.000	-4.589 0.000	-14.092 0.000	-7.945 0.000
P4	-24.197 0.000	-7.476 0.000	-14.107 0.000	-11.239 0.000

ADF is the augmented Dickey-Fuller unit root test, with 5% critical value of -2.86.
The p-value presents the probability to accept the null hypothesis of non-stationary series.
The variable of liquidity is stationary at first difference.

3.2 The Relationship between Trading Activity and Liquidity

The market liquidity variable, as measured by the bid-ask spread BAS , is regressed on the trading activity variable. The sample consists of the 20 companies listed in the TSE from 04, January 2010 through 31 December 2015 for a total of 1460 trading days. Market liquidity variable is measured as the simple average of either individual liquidity across companies, while the trading activity is measured as the simple average of the number of transactions (NT) or trading volume (VOL) across companies.

The regression takes the following form.

$BAS_t = \alpha_0 + \alpha_1 \, ACTIVITY_t + \varepsilon_t$, (1)

Where ACTIVITY indicates natural logarithm of either the number of transactions (NT) or the trading volume (VOL). The equation is estimated by the GMM estimation method and the standard errors are adjusted according to the Newey and West adjustments for serial correlation and/or heteroscedasticity [24]. The test-statistics are reported below their respective coefficient values.

	All companies	P1 : (0-110000)	P2 : (110000- 315000)	P3 : (315000- 800000)	P4 : (800000- 2000000)
constant	5.977748 (8.957404)*	1.205498 (7.960967)*	1.671846 (8.440085)*	6.101205 (8.296433)*	4.248079 (4.580913)*
NT	-1.459131 (-7.615157)*	-0.212662 (-5.640914)*	-0.380988 (-6.881077)*	-1.336864 (-5.800297)*	-0.676322 (-2.438529)**
R^2	0.178757	0.090607	0.163551	0.068810	0.020452

*Denotes statistically significant parameters at the 1% level,
**Denotes statistically significant parameters at the 5% level.

Table A: Trading Activity as Measured by Number of Transactions

	All companies	P1 : (0-110000)	P2 : (110000- 315000)	P3 : (315000- 800000)	P4 : (800000- 2000000)
constant	7.837173 (6.329920)*	1.532967 (6.256355)*	2.169385 (6.197840)*	6.672958 (5.160422)*	2.396753 (1.646082)***
VOL	-0.767069 (-5.454639)*	-0.118915 (-4.746286)*	-0.194739 (-5.202734)*	-0.534956 (-3.216114)*	-0.034062 (-0.190687)
R^2	0.082425	0.059487	0.084636	0.018975	0.000106

*Denotes statistically significant parameters at the 1% level,
*** Denotes statistically significant parameters at the 10% level.

Table B: Trading Activity as Measured by Trading Volume

Table A and B report the results from regressing BAS on trading activity variables. Table A shows the results for trading activity as measured by the number of trades, while Table B shows the estimation results for trading volume as a measure of trading activity. The activity liquidity results are also segregated into four different portfolios to show the effect of firm value on the relationship. The portfolios are (P1) companies with firm value between 0 and 110000 MD, (P2) companies with firm value between 110000 and 315000 MD, (P3) companies with firm value between 315000 and 800000 MD, and (P4) companies with largest firm value, which is between 800000 and 2000000 MD.

The relationship between liquidity and trading activity is negative for all portfolios.

3.3. The Relationship between Trading Activity and Volatility

We now consider the relationship between trading activity (as proxied by the number of trades and trading volume) and volatility (the standard deviation of daily returns). The trading activity and volatility variables are calculated as the simple average of individual variables across companies for each portfolio and for all companies.

The regression takes the following form:

$STDEV_t = \alpha_0 + \alpha_1 \, ACTIVITY_t + \varepsilon_t$, (2)

Where ACTIVITY indicates either natural logarithm of the number of transactions (NT) or natural logarithm of the trading volume (VOL). The equation is estimated by the GMM estimation method and the standard errors are adjusted according to the Newey and West adjustments for serial correlation and/

or heteroscedasticity [24]. The test-statistics are reported below their respective coefficient values.

	All companies	P1 : (0-110000)	P2 : (110000- 315000)	P3 : (315000- 800000)	P4 : (800000- 2000000)
constant	0.005567 (3.099944)*	0.006527 (4.312888)*	0.005436 (4.684349)*	0.006267 (2.950972)*	-0.001925 (-0.648608)
NT	0.001753 (3.261365)*	0.001843 (4.426762)*	0.001599 (4.108942)*	0.001907 (2.186478)**	0.003576 (3.264446)*
R^2	0.008278	0.026187	0.019290	0.008183	0.008216

*Denotes statistically significant parameters at the 1% level,
** Denotes statistically significant parameters at the 5% level.

Table A: Trading Activity as Measured by the Number of Transactions

	All companies	P1 : (0-110000)	P2 : (110000- 315000)	P3 : (315000- 800000)	P3 : (315000- 800000)
constant	0.000789 (0.276726)	0.002903 (1.073572)	0.000968 (0.396499)	0.002935 (0.775210)	0.002935 (0.775210)
VOL	0.001213 (3.477364)*	0.001117 (3.787549)*	0.001088 (3.729110)*	0.001124 (2.065844)**	0.001796 (2.815899)*
R^2	0.012013	0.020201	0.017675	0.004887	0.004237

*Denotes statistically significant parameters at the 1% level,
**Denotes statistically significant parameters at the 5% level.

Table B: Trading Activity as Measured by the Trading Volume

All the coefficients of trading activity variables, both NT and VOL in both tables, exhibit positive signs, and they are statistically significant. The results show that an increase in trading leads to a more volatile market, and the effect is observed across different portfolios. Our results also support Jones et al. in that both measures of trading activity (number of transactions and trading volume) have similar information content [16].

3.4 The Relationship between Volatility and Liquidity

In the empirical literature, it is shown that price, trading activity, and volatility are major factors that affect liquidity [4,12-14,25]. We now consider the relationship between volatility (the standard deviation of daily returns) and liquidity (the bid-ask spread). The volatility and liquidity variables are calculated as the simple average of individual variables across companies for each portfolio and for all companies.

The regression takes the following form:

$$BAS_t = \alpha_0 + \alpha_1 STDEV_t + \varepsilon_t, \quad (3)$$

The equation is estimated by the GMM estimation method and the standard errors are adjusted according to the Newey and West adjustments for serial correlation and/or heteroscedasticity [24]. The test-statistics are reported below their respective coefficient values.

	All companies	P1 : (0-110000)	P2 : (110000- 315000)	P3 : (315000- 800000)	P4 : (800000- 2000000)
constant	1.515933 (10.88157)*	0.424723 (9.330147)*	0.412578 (7.728461)*	2.859313 (10.05293)*	2.178683 (11.34108)*
STDEV	-3.908272 (-1.144754)	1.325418 (0.589906)	3.563780 (1.037690)	2.186602 (0.283199)	-6.642147 (-4.233293)*
R^2	0.000473	0.000454	0.001898	0.000082	0.002592

*Denotes statistically significant parameters at the 1% level,

The column for all companies shows that volatility tends to have a negative relation with liquidity, as indicated by the statistically insignificant STDEV coefficient. Although, the relation is significantly negative for the largest firm-value portfolio. It is not characteristic of other portfolios where the effect of volatility on spread Increases.

4. Conclusion

In the framework of this paper, we test the influence of the firm value on the relationship between equity trading activity, market liquidity and return volatility at the portfolio level. We use the daily bid-ask spread, realized volatility, number of transactions and trading volume of 20 individual stocks listed on the Tunis Stock Exchange from January 04, 2010 to December 31, 2015.

The study finds that higher trading activity is associated with lower liquidity and higher volatility for all portfolios. Therefore, we can conclude that the firm value has not an impact on the relation between trading activity and liquidity, and the relation between trading activity and volatility. Although, it has an impact on the relation between volatility and liquidity which is negative for the largest firm value portfolio and positive for other portfolios [26,27].

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