

An Analysis of Aggregate Market Liquidity: The Case of Amman Stock Exchange

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Abstract

The purpose of this study is to analyze the behavior, the day-of-the-week regularities and the macroeconomic determinants of aggregate market liquidity of emerging stock markets through studying Amman Stock Exchange (ASE). The study investigates all the stocks traded in ASE over the period 2002-2010. Aggregate market liquidity is measured by several proxies, each reflecting a certain dimension. It is calculated as an average of individual stock liquidity proxies and as a sum of trading activity measures. Aggregate market liquidity shows a fluctuating pattern throughout the study period. It gets worse in the mid-week. Spread and depths show their maximum values on Mondays and Sundays, respectively. The trading activity reaches its minimum on Sunday and its maximum on Thursday. Major macroeconomic factors significantly affect aggregate market liquidity, though; aggregate market return and volatility exercise a larger effect. This study is the first to conduct a comprehensive analysis of aggregate market liquidity in an emerging stock market.

Keywords: Aggregate market liquidity, Day-of-the-week effect, Macroeconomic factors, Amman Stock Exchange, Time series analysis

1. Introduction

Liquidity is a very important feature of financial markets. It is a multi-dimensional phenomenon concerning the quickness and ease of trading without a significant price change. Early literature focused on individual stock liquidity and its effect on return. However, aggregate market liquidity has been the focus of researchers since the beginning of the last decade. Investors, business organizations, regulators, policy makers and others do concern about the behavior and determinants of aggregate market liquidity given its importance for the functioning of the stock exchanges and for the economy as a whole. This study constructs a comprehensive analysis of aggregate market liquidity in ASE, an emerging stock market, over the period 2002-2010. The analysis includes three main parts; the behavior, the day-of-the-week effect and the macroeconomic determinants.

Understanding the drivers and possible seasonality effects of market liquidity is without doubt vital. Some reasons could be mentioned. First, Liquidity is a core function of the market. Investors enter the market either supplying or demanding liquidity. Second, market liquidity is also an essential factor influencing both the aggregate market return and the individual stock return. Third, fluctuations of market liquidity could predict financial crises. A recent study for Naes *et al.* (2011) concerning the last global financial crises shows that liquidity in the stock market desiccating as a sign to the crisis in the real economy. To the best of the researcher's knowledge, understanding the behavior of aggregate market liquidity in emerging markets is still limited. This study inspects whether the characteristics, determinants and day-of-the-week regularities of aggregate market liquidity in an emerging market are comparable to developed ones.

Our findings can be summarized as follows: market liquidity shows a fluctuating pattern throughout the study period. In particular, it has moved upward from the beginning of the study period to 2005 and downward thereafter. We argue that there was no direct effect of the global financial crisis on the ASE given its local nature. However, the global financial crisis has indirectly affected the ASE through its effect on investors' psychologies and thus their willingness to invest. There are significant day-of-the-week regularities in market liquidity. Contrasting the US evidence of Chordia *et al.* (2001), market liquidity reaches its minimum in the middle of the week. Trading activity is significantly higher in Thursdays and lower in Sundays comparing to other days of the week. Jordanian Investors seem to avoid trading at the beginning of the week given the higher adverse selection costs. This is consistent with

Foster and Viswanathan (1993) who found analogous results of the trading volume for NYSE. Spreads show their maximum values on Mondays while depths do so on Sundays. Gross Domestic Product (GDP), Money Supply (M2), Industrial Production (IP), Consumer Price Index (CPI), Unemployment rate (UNEMP), term spread (TERM) and quality spread (CREDIT) do significantly affect different proxies of liquidity. Nevertheless, aggregate market return and volatility appear to have the largest and most significant effects on aggregate market liquidity.

The remainder of the study is organized as follows. Section 2 reviews the related literature. Section 3 briefly introduces ASE. Section 4 describes our data. Section 5 presents the research methodology. Section 6 reports the empirical results and Section 7 concludes on the main findings.

2. Literature Review

Chordia *et al.* (2000) have shifted the focus of liquidity research from the individual stock level to the overall market level. Indeed, the authors introduced a new phenomenon called commonality in liquidity and defined it as the co movement between individual stock liquidity and market liquidity. The commonality is found to exist in developed markets (Huberman & Halka, 2001; Hasbrouck & Seppi, 2001; Giouvris, 2003) as well as in emerging markets (Brockman & Chung, 2002; Sujoto *et al.*, 2005; Qin, 2007). Launching this area of research, authors have moved toward analyzing aggregate market liquidity, (Chordia *et al.*, 2001; Fujimoto, 2003) and investigating whether its variations affect stock returns (Jones, 2002; Amihud, 2002; Bekaert *et al.*, 2003; Pastor and Stambaugh, 2003; Gibson & Mougeot, 2004; Acharya & Pedersen, 2005; Liu, 2006).

Our work is related to several parts of the finance literature. One important part is the regularities in stock market. Voluminous literature has documented a day-of-the-week effect in stock returns. The effect typically happens when stock returns are negative on Monday or lower than the returns of the other days. On the other hand, Friday returns are highest among all other days. Cross (1973), French (1980), Gibbons and Hess (1981), Lakonishok and Levi (1982), Keim and Stambaugh (1984), Rogalski (1984), Harris (1986), Smirlock and Starks (1986), Lakonishok and Smidt (1988) and Mehdi and Perry (2001) are among others who find a day-of-the-week effect in the US stock market. The anomaly is found to exist in most developed and emerging stock markets all over the globe (Lyroudi *et al.*, 2002; Paudyal & Draper, 2002; Patev *et al.*, 2004; Kenourgios & Samitas, 2005; Dicle & Hassan, 2007; Choudhary & Choudhary, 2008; Dicle & Levendis, 2010; Huang *et al.*, 2010). Comparing with this huge research on the daily regularities of stock returns, very little is known about regularities in aggregate stock market liquidity.

Other related literature to this study is about the macroeconomic effects on stock market. Earlier research has focused on the effect of macroeconomic factors on stock returns. Chen *et al.* (1986) have started this line of research. They find that term structure, industrial production, risk premium, inflation, market return, consumption and oil prices significantly explain the returns in the US stock market. Following studies confirm the explanatory power of macroeconomic variables on stock returns, (Chen, 1991; Patelis, 1997; Thorbecke, 1997; Ferson & Harvey, 1999; Mayasami & Koh, 2000; Gan *et al.*, 2006; Alzubi & Salameh, 2007; Cunsel & Cukur, 2007; Gay, 2008; Tursoy *et al.*, 2008; Mohammad *et al.*, 2009; Pal & Mittal, 2011). Parallel to these studies, some authors document a significant relationship between macroeconomic variables and stock market liquidity. Sen and Ghosh (2008) find that Index of Industrial Production, Consumer Price Index, Exchange Rate, Gold price and Money Supply have significant positive effects on the Indian Stock Market liquidity. Liquidity is measured by turnover rate and Amivest ratio. Lu and Glascock (2010) find that the pricing of liquidity can be partially explained by business cycles and the rate of growth in industrial production in the US stock markets. Naes *et al.* (2011) uncover a strong relation between stock market liquidity and the business cycle. Choi and Cook (2005) report that liquidity shocks in the Japanese Stock Market are associated with some macroeconomic events. Soderberg (2008) investigates the macroeconomic variables' ability to forecast changes in monthly liquidity on the Scandinavian order-driven stock exchanges and reports weak evidence.

There is a direct link between our study and those of Chordia *et al.* (2001) and Fujimoto (2003). Chordia *et al.* (2001) examine the time varying characteristics and the determinants of aggregate market liquidity of NYSE over the period 1988-1998. They find that aggregate market spreads, depths and volume are highly volatile and their daily changes are serially correlated. Market return, market volatility, short term interest rate and term spread are significant explanatory variables for market liquidity. Moreover, a day-of-the-week effect is apparent. Fridays encompass lowest liquidity while Tuesdays are most liquid. Over the last four decades, Fujimoto (2003) investigates the macroeconomic sources of aggregate market liquidity in US markets as well. Their results can be summarized as follows. The supply-side inflation and monetary policy shocks are the main macroeconomic factors that explain the time varying behavior of aggregate market liquidity. Market liquidity increases significantly in return to negative inflation shocks and expansionary monetary policy shocks. In addition to the direct effect, the two macroeconomic factors indirectly affect market liquidity through their effect on market variables as return, volatility and turnover.

However, the effect is time varying. Thus, it has lessened over the last two decades given that the economy has developed into more steadiness.

3. Amman Stock Exchange

ASE is an emerging stock market that has been established in 1976. It applies an automated order driven system. Investors cannot trade unless through brokers. The brokers trade on the system remotely (from their offices) or use trading screens located in the ASE head quarters. They trade on behalf of their customers and for their own inventory. Trading takes place in a continuous basis. Specifically, the brokers enter buy and sell orders into the trading system.

The system arranges orders according to price/time priority. In particular, bid prices are ordered in priority from highest to lowest, while ask prices are arranged from lowest to highest. Bid-ask spread is defined as the difference between the lowest ask price and the highest bid price. Depth is a function of the average number of shares available at the lowest ask and highest bid prices. Again, the system matches orders and executes them according the price/time priority. Trade size is not a priority in execution. The system keeps the traders anonymous until the order is executed. This order driven trading system has different provisions of liquidity providing from the dealership markets. Investors rather than dealers are the liquidity providers. There is no obligation for the investor to provide liquidity and thus no inventory risk exists. The investors face only information asymmetry risk. The market is free to enter or exit.

In addition to the trading system, one more issue is worthy to mention about the ASE, its key statistics. According to the statistics of 2010, ASE consists of 277 companies with a market capitalization of JD 21,858.2 millions. The market capitalization represents 122.7% of the GDP. The daily trading volume averages approximately JD 26.75 millions. The number of traded shares and the number of transactions per year are 6988.8 million and 1880.2 thousand, respectively. Finally, the number of trading days is 250.

4. Data

The data set consists of daily closing trading data for all the stocks that are traded in ASE throughout the period 2002-2010, inclusive. For each stock, it includes the daily quantity and dinar trading volume, the opening and closing prices for the day, the highest and lowest prices during the day, the daily number of trades and the best quoted bid and ask prices and their corresponding quoted quantities. All the companies that are traded in any day are included with no any exception. This may enrich the analysis of aggregate market liquidity. Moreover, quarterly data of macroeconomic variables are obtained from the Central Bank of Jordan (CBJ). These variables are: GDP, M(2), IP, CPI, UNEMP, and the interest rate on Treasury bills, Treasury bond, and loans. Eight liquidity measures are employed, the absolute quoted bid-ask spread (SPR), the proportional quoted bid-ask spread (PSPR), the quoted quantity depth (DEP), the quoted dinar depth (DDEP), the Amihud's (2002) illiquidity ratio (AM), the number of trades (NO), the quantity trading volume (QTY) and the dinar trading volume (VOL). Obviously, the study uses a number of different measures in order to reflect the different dimensions of liquidity. SPR and PSPR reflect the cost dimension, DEP and DDEP indicate by definition the quantity dimension, QTY, VOL and NO are related to the trading activity aspect of liquidity and AM is a proxy for price impact. The calculations of these measures are shown in Table 1. Aggregate market values of SPR, PSPR, DEP, DDEP and AM in a certain day are calculated by averaging their values for all the stocks that are traded on that day. However, aggregate market values of QTY, VOL and NO are calculated by summing their values for all the stocks that are traded on a certain day.

5. Methodology

Three different methods are used in this study. Descriptive statistics and charts are used to describe the behavior of aggregate market liquidity throughout the study period. The day-of-the-week effect is investigated through estimating the following time series regression model which includes five dummy variables, one for each day of the week:

$$L_t = B_1 D_{1t} + B_2 D_{2t} + B_3 D_{3t} + B_4 D_{4t} + B_5 D_{5t} + \sum_{j=1}^{10} B_{j+5} \times L_{t-j} + e_t \quad (1)$$

L_t : is the aggregate market liquidity on day t .

D_{jt} : are dummy variables which take on the value 1 if the corresponding liquidity for day t is a Sunday, Monday, Tuesday, Wednesday or Thursday, respectively and 0 otherwise.

The model is estimated without an intercept in order to avoid the dummy variable trap (for more information, see Gujarati, 2004). The OLS estimation of this model show significant ARCH effects. In other words, the variance of the residuals obtained from the estimation of the model is time-dependent. Consequently, GARCH (1,1) model of Bollerslev (1986) is used in order to solve this problem. Moreover, ten days lags of the dependent variable are added

as supplementary regressors so as to correct for the autocorrelation between residuals. A different liquidity proxy is used each time the model is estimated with the purpose of investigating the day-of-the-week regularities in the different dimensions of aggregate market liquidity.

The last part of the study examines the effect of macroeconomic variables on aggregate market liquidity through the OLS estimation of the following time series regression model:

$$CL_t = B_0 + B_1 CGDP_t + B_2 CM2_t + B_3 CCPI_t + B_4 CIP_t + B_5 CTERM_t + B_6 CCREDIT_t + B_7 CUNEMP_t + B_8 MKT_t + B_9 VOT_t + e_t \quad (2)$$

Where

CL_t : is the percentage change in aggregate market liquidity in quarter t

$CGDP_t$: is the percentage change in Gross Domestic Product in quarter t

$CM2_t$: is the percentage change in Money Supply (2) in quarter t

$CCPI_t$: is the percentage change in Consumer Price Index in quarter t

CIP_t : is the percentage change in Industrial Production Index in quarter t

$CTERM_t$: is the percentage change in Term Spread in quarter t

$CCREDIT_t$: is the percentage change in Credit Spread in quarter t

$CUNEMP_t$: is the percentage change in Unemployment Rate in quarter t

MKT_t : is the rate of return on stock market index

VOT_t : is the aggregate market volatility measured by averaging the individual stocks' squared returns.

Literature suggests a long list of different variables in order to represent the economic conditions. This study uses the macroeconomic variables that have sufficient data available from the CBJ. Augmented Dickey-Fuller and Phillips-Perron unit root tests show a nonstationarity problem in the time series. Daily percentage changes rather than levels are used for the dependent and independent variables in order to avoid it. Market return and volatility are added as control variables in order to isolate their possible effects on aggregate market liquidity. Newey-West HAC Standard Errors and Covariance is used to account for heteroskedasticity and serial correlation in the obtained residuals. Regression is estimated on a quarterly basis because some macroeconomic variables such as credit term are only available on that basis. Other studies use longer periods of time to examine this issue, however, the unavailability of data has limited this study to a 9-year period. Yet, this does not affect the reliability of the regression results. According to the central limit theorem, 30 observations are enough to run an OLS regression. In our case, 36 observations are employed. Chow Break Point test is used to check for any structural changes in data.

A Vector Autoregression (VAR) is also estimated for equation (2) in order to explore any dynamics in the relationships. A lag length of 2 is employed and selected according to Akaike Information Criterion (AIC).

6. Empirical Results

6.1 Descriptive Statistics

Descriptive statistics of liquidity variables are reported in Table 2. All liquidity variables are highly volatile indicated by the high values of coefficient of variation. As an emerging market, these values are even higher than their comparable ones of NYSE documented by Chordia *et al.* (2001). Means and medians differ significantly demonstrating that none of these liquidity variables is normally distributed.

Figure 1 plots the AM; it has declined through 2002-2003, stabilized through 2004-2005, and showed an increase through 2006-2007. Over the first half of 2008, the AM has decreased. However, it has increased rapidly starting from the mid of 2008 to the end of 2010. Spread measures in Figure 2 show a similar trend to the AM. Figure 3 shows the depth measures, they display two main increases in 2005 and 2008. Trading volume measures in Figures 4 and 5 exhibit an opposite behavior to the AM. They have increased through 2002-2005, declined through 2006-2007. However, they reached their maximum in mid 2008 and then have declined thereafter to the end of the sample period. Overall, aggregate market liquidity has improved through 2002-2005 because of the technical and the legal developments of ASE. In 2006 and 2007 the trading volume decreased and the economy slow down although of the establishment of a number of companies. Most exchanges in the world witnessed a hold up in 2006. The situation has improved in the first half of 2008. However, a significant brake happened in the mid of 2008. Liquidity has dried up swiftly through 2009-2010. The direct reason could be initiating an investment substitute. A large number of companies that trade in the global equity markets and FOREX were established. Most Jordanian

investors direct their investments toward these companies. This, in turn, has pulled liquidity from the ASE. The global financial crises can be an indirect reason through its effect on the Jordanian investors' psychologies. Fears from the possible effects of the global financial crises on the Jordanian economy have limited their investments in ASE.

6.2 Regularities of Liquidity

Table 3 presents the regression results for the day-of-the-week regularities of aggregate market liquidity. AM shows significant coefficient on Wednesday. Thus, liquidity seems to be poorer in the middle of the week. Spread measures reach their maximum on Mondays. On the other hand, depth measures are highest on Sundays. Both coefficients are statistically significant. Trading activity measures show some how different results. QTY and VOL exhibit their greatest values on Thursday. They show negative coefficients on Sunday. NO has also a negative coefficient on Sunday. Different liquidity measures show different results. This may be due to the fact that each liquidity proxy reflects a specific aspect of liquidity.

Our results are dissimilar to those reported by Chordia *et al.* (2001) for NYSE. In particular, Chordia *et al.* (2001) document that aggregate market liquidity and trading activity are highest in mid-week, lowest on Fridays. The contradictory results may arise from the nature of ASE. As an emerging market, investors' psychologies do have a large effect on their trading behavior. They seem to be conservative to trade at the beginning of the week given the ambiguity surrounding stock prices. This is consistent with the information asymmetry paradigm (Bagehot, 1970; Copeland & Galai, 1983; Glosten & Milgrom, 1985) under which investors avoid trading when the adverse selection cost is high. The opposite happens on the last day of the week where all information is already revealed. Foster and Viswanathan (1993) found similar results with respect to trading volume in NYSE.

6.3 Macroeconomic Sources of Aggregate Market Liquidity

Table 4 displays the OLS regression results of the macroeconomic sources of aggregate market liquidity. The regression is estimated on quarterly basis (Daily percentage changes in aggregate market liquidity are transformed into quarterly basis). Percentage changes in IP, M2 and UNEMP significantly affect the percentage change in the aggregate market AM. The IP has a negative effect while the other two variables have positive effects. There is no statistically significant effect of macroeconomic variables on spread and depth measures. This is in some way consistent with Chordia's *et al.* (2001) results who find no significant effect of GDP and unemployment announcements on bid-ask spreads. One could explain that investors do not directly consider the macroeconomic conditions when they quote their bid-ask quantities and prices. Trading activity measures, on the other hand, are highly affected by macroeconomic variables. Most coefficients are statistically significant. The coefficients of percentage changes in GDP, UNEMP and CREDIT are negative. The adjusted R squared of the estimated regressions ranges from 26% when DEP proxies for liquidity to 78% when liquidity is measured by VOL. The analysis reveals one important outcome; that is, in all regressions the coefficients of aggregate MKT and VOT are the largest and the most significant among others. This exerts their vital explanatory power of aggregate market liquidity. Indeed, these market variables are more essential in explaining the aggregate market liquidity than the macroeconomic variables.

Table 5 reports the results of the Chow test based on 2006 as a break point. The test shows no significant structural changes in the relationship between macroeconomic indicators and most of liquidity and trading activity measures. Finally, Table 6 reveals some lagged effects of the variables examined on aggregate market liquidity indicating some temporal associations explored by the VAR.

7. Conclusion

This study analyses the behavior, regularities and macroeconomic determinants of aggregate market liquidity in ASE through the period 2002-2010. The Aggregate market liquidity showed an upward trend throughout 2002-2005. The main reason is what the market has witnessed of improvement on the technological and the legal levels. In 2006 and 2007 it has slowed down given the sluggish economy not only in Jordan but all over the world. The situation showed an improvement at the beginning of 2008 however a down trend has started from the mid of 2008 to the end of the sample period. The latter trend according to the author argument could be as a result of establishing companies that trade in the global equity markets and FOREX. Investing in such companies was a substitute to the investment in ASE for the Jordanian investor. One other explanation is the global financial crises which affect our investors' willingness to invest. Thus, it has directed the investor toward saving rather than taking the risk of investment, especially in financial assets.

Day-of-the-week effect is not only limited to the stock market return. It also characterizes its aggregate market liquidity. Liquidity worsens in the mid-week. Spread and depths show their maximum values on Mondays and

Sundays, respectively. The trading activity illustrates its minimum on Sunday and reaches its maximum on Thursday.

Macroeconomic factors exert significant effects on aggregate market illiquidity ratio and trading activity measures, however, their effect is small if compared with the aggregate market return and volatility.

Our findings are important to market practitioners in ASE. Investors who enter the market to buy or sell will be concerned about when it is liquid. Regulators and policy makers will also be interested to know what determines the aggregate market liquidity. Finally, business organizations will choose their financing sources according to the required rates of return on their stocks which in a manner depends in a large extent on market liquidity.

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Table 1. Liquidity measures

Absolute Quoted Bid-Ask Spread (SPR)	$SPR_{i,t} = P_{i,t}^A - P_{i,t}^B$ where: $P_{i,t}^A$ is ask price of stock i at time t . $P_{i,t}^B$ is bid price of stock i at time t
Proportional Quoted Bid-Ask Spread (PSPR)	$PSPR_{i,t} = \frac{(P_{i,t}^A - P_{i,t}^B)}{(P_{i,t}^A + P_{i,t}^B)/2}$
Quoted Depth (DEP)	$DEP_{i,t} = \frac{Q_{i,t}^A + Q_{i,t}^B}{2}$ where: $Q_{i,t}^A$ is ask quoted quantity of stock i at time t . $Q_{i,t}^B$ is bid quoted quantity of stock i at time t
Quoted Dollar Depth (DDEP)	$DDEP_{i,t} = \frac{Q_{i,t}^A * P_{i,t}^A + Q_{i,t}^B * P_{i,t}^B}{2}$
Amihud's (2002) Illiquidity Ratio (AM)	$AM_{i,t} = \frac{ R_{i,t} }{VOL_{i,t}}$ where: $VOL_{i,t}$ is the dollar volume of stock i at time t . $R_{i,t}$ is the return on stock i at time t

Table 2. Descriptive statistics

	AM	SPR	PSPR	DEP	DDEP	QTY	NO	VOL
Mean	0.000	0.129	0.085	9051	16713	13919100	9175	36644923
Median	0.000	0.108	0.064	6640	11058	12553618	8906	28903610
Maximum	0.001	2.885	1.367	63427	269074	99395426	29883	447×10 ⁶
Minimum	0.000	-2.086	-0.826	1175	1455	282593	453	451315
Std. Dev.	0.000	0.291	0.162	7220	19456	10901278	5600	33461187
Skewness	4.167	1.271	1.738	2.079	4.085	1.569	0.509	2.091
Kurtosis	28.206	19.547	13.278	9.401	30.284	8.260	2.772	15.081
C of V	1.601	2.251	1.919	0.798	1.164	0.783	0.610	0.913

Notes: Am is the Amihud's (2002) illiquidity ratio; SPR: is the quoted bid-ask spread; PSPR is the quoted proportional bid-ask spread; DEP: is the quoted quantity depth; DDEP: is the quoted dinar depth; QTY: is the quantity trading volume; NO: is the number of trades; VOL: is the dinar trading volume.

Table 3. Day-of-the week-effects

Variable	AM	SPR	PSPR	DEP	DDEP	QTY	NO	VOL
Sunday	0.000	0.004	0.004*	385*	1809	-168327	-19	-649918
Monday	0.000	0.010*	0.005*	154	1107	155067	175*	1992283*
Tuesday	0.000	0.002	0.002	186	817	72355	32	1124700
Wednesday	0.000*	0.001	0.001	186	751	81940	-56	1431990
Thursday	0.000	0.002	0.004*	98	683	347814	47	2091959*
$L_{(-1)}$	0.137*	0.327*	0.379*	0.483*	0.453*	0.449*	0.638*	0.844*
$L_{(-2)}$	0.144*	0.045	0.084*	0.092*	0.042*	0.164*	0.131*	-0.150*
$L_{(-3)}$	0.124*	0.084*	0.089*	0.086*	0.104*	0.045*	0.049	0.123*
$L_{(-4)}$	0.105*	0.084*	0.065*	0.047	0.040*	0.077*	0.048	0.093*
$L_{(-5)}$	0.110*	0.068*	0.068*	0.071*	0.015	0.081*	0.041	-0.006
$L_{(-6)}$	0.089*	0.043	0.027	0.044	0.056*	-0.060*	-0.022	0.000
$L_{(-7)}$	0.056*	0.111*	0.075*	0.015	0.007	0.181*	0.047	0.085*
$L_{(-8)}$	0.025	0.053	0.066*	0.040	-0.028	0.025	0.058*	-0.133*
$L_{(-9)}$	0.108*	0.083*	0.008	0.024	0.059*	0.045*	-0.027	0.087*
$L_{(-10)}$	0.062*	0.035	0.061*	0.068*	0.139*	-0.009	0.028	0.006
Variance Equation								
C	0.000*	0.000	0.000	153316*	1.27×10 ⁸ *	1.1×10 ¹³ *	715*	1.3×10 ¹³ *
RESID(-1) ²	0.238*	0.164*	0.146*	0.350*	0.994*	0.518*	0.029*	0.769*
GARCH(-1)	0.842	0.872	0.882	0.745*	-0.010	0.079	0.973*	-0.061
R ²	0.297	0.293	0.384	0.644	0.467	0.853	0.904	0.781
Adjusted R ²	0.291	0.288	0.379	0.641	0.463	0.852	0.903	0.779

Notes: Daily aggregate market liquidity is regressed using GARCH (1, 1) model on five dummy variables, one for each day of the week. The aggregate market liquidity is measured by a different proxy each time regression is run. L is the aggregate market liquidity. Am is the Amihud's (2002) illiquidity ratio; SPR: is the quoted bid-ask spread; PSPR is the quoted proportional bid-ask spread; DEP: is the quoted quantity depth; DDEP: is the quoted dinar depth; QTY: is the quantity trading volume; NO: is the number of trades; VOL: is the dinar trading volume. Ten days lags of the dependent variable are added as additional regressors in an attempt to correct for the autocorrelation between residuals. * denotes statistical significance at 5% level.

Table 4. Macroeconomic sources of liquidity (OLS)

Variable	CAM	CSPR	CPSPR	CDEP	CDDEP	CQTY	CNO	CVOL
C	-0.678*	600	0.974	-0.389	-0.619*	-0.424	-0.349*	-0.645*
CGDP	1.840	296	-0.381	-0.608	-0.960	-2.165*	-1.429*	-3.126*
CM2	13.234*	-32186	-80.362	-1.930	-1.460	-2.445	-1.572	0.831
CCPI	2.980	10756	31.839	-0.021	9.538*	-1.909	0.563	4.650*
CIP	-4.761*	2875	3.721	-0.071	2.071	2.433*	1.973*	3.590*
CTERM	0.122	-1088	-2.970	-0.066	0.118	0.053	0.060	0.298*
CCREDIT	0.196	-1099	-2.699	0.071	0.229	-0.173	-0.064	-0.022
CUNEMP	2.936*	18.184	5.884	0.722	0.868	-0.934*	-0.463	-0.754*
MKT	-111*	-136410	-463	79*	77*	82*	60*	118*
VOT	286	678944	2406	601*	620*	739*	489*	735*
R ²	0.563	0.588	0.566	0.489	0.689	0.636	0.797	0.847
Adjusted R ²	0.367	0.403	0.370	0.259	0.549	0.472	0.706	0.778

Notes: Percentage change in aggregate market liquidity is regressed in a quarterly basis on the percentage change in each of the following macroeconomic variables: GDP is the Gross Domestic Product; M2 is the Money Supply (2); IP is the Industrial Production, CPI is the Consumer Price Index, UNEMP is the Unemployment rate; TERM is the term spread; CREDIT is the quality spread. "C" preceding each acronym denotes the percentage change from quarter $t-1$ to quarter t . Percentage changes are used to avoid nonstationarity problem. Market return (MKT) and volatility (VOT) are added as additional regressors in order to control their effect on the dependent variable. The aggregate market liquidity is measured by a different proxy each time regression is run. Am is the Amihud's (2002) illiquidity ratio; SPR is the quoted bid-ask spread; PSPR is the quoted proportional bid-ask spread; DEP is the quoted quantity depth; DDEP is the quoted dinar depth; QTY is the quantity trading volume; NO is the number of trades; VOL is the dinar trading volume. OLS is used as an estimator with Newey-West HAC Standard Errors & Covariance to account for serial correlation and heteroskedasticity. * denotes statistical significance at 5% level.

Table 5. Chow Break Point Test

Chow test	CAM	CSPR	CPSPR	CDEP	CDDEP	CQTY	CNO	CVOL
F-statistic	1.015	0.360	0.671	0.416	1.364	1.210	3.254*	1.189
Probability	0.491	0.939	0.730	0.909	0.316	0.384	0.038	0.395

Notes: Chow Break Point Test assumes a null hypothesis of no structural changes in data. 2006 is selected as a break point.

Table 6. Macroeconomic sources of liquidity (VAR)

Variable	CAM	CSPR	CPSPR	CDEP	CDDEP	CQTY	CNO	CVOL
CL(-1)	0.334	0.620	0.492	-1.031*	-0.713	0.288	1.087	0.452
CL(-2)	-0.163	-0.806	-1.560	0.236	0.137	-0.661*	-0.364	-1.076
CGDP(-1)	3.250	15715.500	12.792	-5.383*	-4.381	-3.161	-1.341	-4.784
CGDP(-2)	0.368	-14207.320	-65.469	0.074	-0.013	0.645	0.733	-1.647
CM2(-1)	-7.002	34117.500	203.721	-1.323	6.418	8.377*	5.124	12.496*
CM2(-2)	5.214	-14724.670	20.805	-13.759*	-4.212	-7.223	-7.355	-4.389
CCPI(-1)	4.171	61347.520	193.958*	2.971	2.071	-10.514	-6.277	-18.935*
CCPI(-2)	6.749	-61068.760*	-107.802	-2.516	-6.745	-3.524	0.875	7.785
CIP(-1)	3.832	-12755.900	-28.298	3.378*	2.485	0.472	-3.568	-0.879
CIP(-2)	-2.475	-4106.585	2.226	4.087	1.817	3.183	2.463	7.977*
CTERM(-1)	-0.363	2111.983	8.877	-0.091	0.196	-0.317	-0.111	-0.333
CTERM(-2)	0.556	-1508.304	-3.199	-0.222	0.180	0.469*	0.020	0.869*
CCREDIT(-1)	-0.547	2670.100	0.328	0.133	-0.156	-0.103	-0.035	-0.372
CCREDIT(-2)	0.309	-2698.496	-9.000	0.074	0.096	-0.003	0.175	0.468*
MKT(-1)	-68.313	-525548.200	-2236.831	49.596	78.575	14.772	-32.713	74.358
MKT(-2)	-152.114*	13329.950	-1086.149	14.533	60.745	96.381	98.418	202.095
VOT(-1)	-697.400	-464121.500	4947.244	952.872*	1026.255*	578.270	257.958	1156.690*
VOT(-2)	732.408	3145549.000	10788.700*	-948.236*	-933.445*	-185.264	-419.980	-494.819
CUNEMP(-1)	-4.506*	-8513.323	-22.984	-1.109	-0.920	0.080	1.787	1.990
CUNEMP(-2)	-0.326	-3750.816	1.972	-3.244*	-2.504*	-3.040*	-0.207	-2.511
C	-0.270	-3359.140	-20.253	0.889*	0.183	0.072	0.369	-0.346
R-squared	0.913	0.782	0.841	0.946	0.907	0.944	0.856	0.924
Adj. R-squared	0.563	-0.092	0.206	0.732	0.534	0.719	0.281	0.620

Notes: VAR is estimated for the same variables in Table 4. All variables are set as endogenous except the intercept. A lag structure of 2 is selected according to AIC.

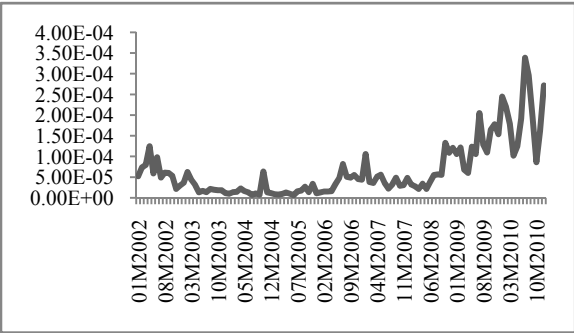


Figure 1. Illiquidity Ratio

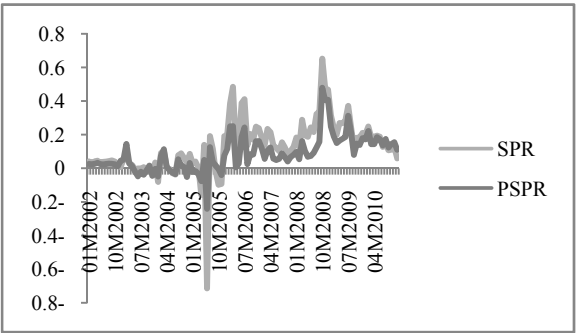


Figure 2. Spread Measures

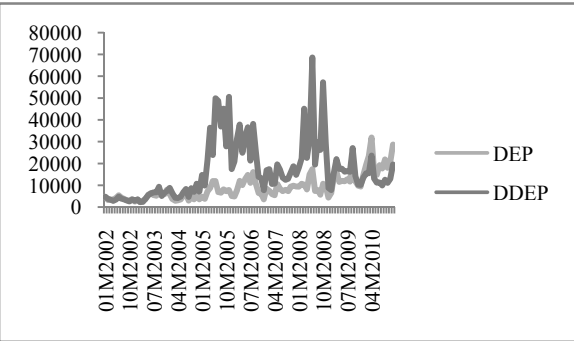


Figure 3. Depth Measures

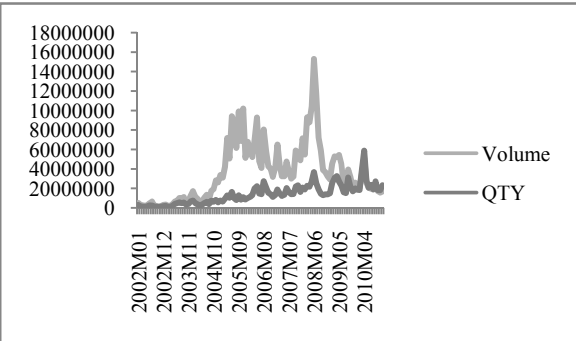


Figure 4. Trading Activity Measures

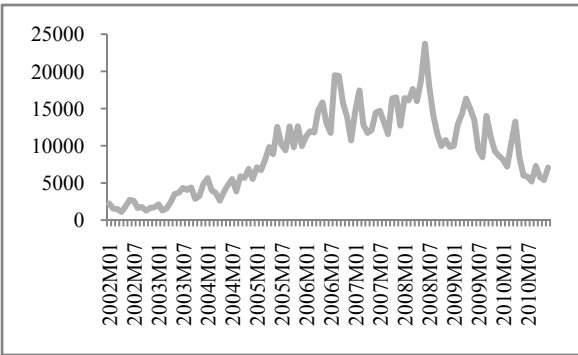


Figure 5. Number of Trades