CHAPTER – IV

MEASURES OF STOCK MARKET LIQUIDITY

4.1. Introduction

While the importance of liquidity in the context of stock market is widely acknowledged, considerable disagreement as regards to the quantification of the same could be noticed. Consequently, a large variant of the techniques have been suggested by various researchers. The volume of these works is such that one could hardly prepare any exhaustive list of all the measures. However, an attempt is made here to prepare a list of widely known measures of liquidity in the following sections:

4.2. One-dimensional Liquidity Measures

These measures take into consideration only one stock market variable at a time. Examples of one-dimensional measure are given below:

A) Volume Related Liquidity Measures

Volume related liquidity measures usually capture the depth dimension of liquidity but they are also related to the time dimension since a higher volume in the market leads to a shorter time needed for trading of a pre-defined amount of shares. If the volume related liquidity measures are high that indicate higher liquidity. A few of the volume related measures are as follows:

a) Trading Volume

Trading Volume \( (Q_t) \) for a particular time period \( t \) is a measure of liquidity.

Where, \( t \) may denote any time period like hour, day, month or year as the case may be.
Symbolically, \[ Q_t = \sum_{i=1}^{N_t} q_i \]

Here, \( N_t \) denotes the number of trades for the period \( t \), \( q_i \) is the number of shares of trade \( i \). Lee and Swaminathan (2000), Chordia et al (2001) and Hasbrouck and Saar (2002) use Trading Volume as a measure of liquidity in their respective studies.

b) Turnover

Like trading volume Turnover \( (V_t) \) is often used as the measure of liquidity. Chordia et al (2001), Lee and Swaminathan (2000) etc have used this measure in their respective studies. Here turnover is calculated for a specific time interval using the following technique:

\[ V_t = \sum_{i=1}^{N_t} p_i q_i \]

Where, \( p_i \) stands for the price for trade \( i \). \( N_t \) denotes the number of trades for the period \( t \) and \( q_i \) is the number of shares of trade \( i \). Chan et al (2002) use ‘net trade volume’ to calculate turnover which is the difference between the buyer- initiated volume and seller- initiated volume. Some- times turnover is adjusted to free float shares as per the requirement of the study. Brunner’s (1996) study is a good example in this regard.

c) Depth

The market depth defined as \( D_t = q_t^A + q_t^B \) has been used in the studies conducted by Huberman et al (2001) and Brockman et al (2000). Here, \( q_t^A \) and \( q_t^B \) refers to the best bid and the best ask volumes in the order book for the time period \( t \) respectively.
Sarin et al (1996) have divided \( D_i \) by 2 to get average depth. The use of such an adjustment is found in the study of Chordia et al (2001) also.

d) Log Depth

A variation of the above method to get normalization of data some times Depth is transformed into natural logarithmic figures in the following form as Butler et al (2002):

\[
\ln D_i = \ln(q^A_i, q^B_i)
\]

B) Time Related Liquidity Measures

Time related liquidity measures capture the frequency of trading per unit of time. Higher values of any of these measures indicate higher liquidity. Number of Transactions per unit of time, number of trades or turnover per unit of time are the examples of this type of application.

Furthermore, waiting time, \( WT_i \) of the following form could also be used:

\[
WT_i = \frac{1}{N-1} \sum_{i=2}^{N} (t_i - t_{i-1})
\]

Here, \( t_i \) denotes the time of trade \( i \) and \( t_{i-1} \) is the time taken to execute the previous trade. Peng (2001) uses this proxy in his study to measure liquidity.

C) Spread Related Liquidity Measures:

The difference between the bid and ask price is called spread. Spread in its variant form is frequently being used as proxies to liquidity. The smaller the value of a spread related measure higher is the liquidity. There may be numbers of such measures. Some of these are presented below:
a) Absolute Spread

The absolute spread (Sabs) is the difference between the lowest ask price (p_A^a) and the highest bid price (p_B^b).

\[ Sabs, = p_A^a - p_B^b \]

This is a widely used measure. Chordia et al (2001) have used this measure in their study conducted on the NYSE while Grammig et al (2001) have used the same in the context of the German Stock Markets.

b) Log-absolute spread

Sometimes in order to get better statistical properties, above measure may be transformed into natural logarithmic figure. Hamao and Hasbrouck (1995) have used such transformation in their study.

c) Relative Spread Calculated with the Mid Price

Relative spread is also an extensively used measure of liquidity. Chordia et al (2001), Hasbrouck and Saar (2002) etc have used this measures.

Symbolically, it may be written as;

\[ SrelM, = \frac{p_A^a - p_B^b}{p_M^M} \]

Where, \( p_M^M \) is the mid price and is equal to \( \frac{p_A^a + p_B^b}{2} \).

d) Relative Spread Calculated with the Last Trade

This measure could be calculated as follows:

\[ Srelp, = \frac{p_A^a - p_B^b}{p_t} \]

Where, \( p_t \) represents the last paid price of the asset before time t. \( p_t \) must be known to calculate the above formula. Amihud and Mendelson (1991) have used the same formula by adding the accrued interest of American Treasury bills with it.
e) Effective Spread

Effective spread ($Seff_t$) could be calculated as:

\[ Seff_t = |p_i - p_i^M| \]

Where, $p_i$ represents the last paid price and $p_i^M$ is the mid price which is equal to $\frac{p_i^A + p_i^B}{2}$.

According to Chordia et al (2000) if effective spread is smaller than half of the absolute spread $[Sabs_t = p_i^A - p_i^B]$ it indicates that trading has been done within the quotes. Effective spread could also be transformed into relative effective spread calculated with last trade $[Seffrelp_t = \frac{|p_i - p_i^M|}{p_i}]$ and relative effective spread calculated with mid price $[SeffrelM_t = \frac{|p_i - p_i^M|}{p_i^M}]$.

4.3. Multi-dimensional Liquidity Measures

These measures take into consideration more than one stock market variables at a time. There are many such measures. Some of those are discussed below:

a) Market Efficiency Coefficient (MEC)

The MEC has been originally developed by Hasbrouck and Schwartz (1987) and in the Indian context it has been used by Krishnamurti and Lim (2000). The procedure of computing MEC as described by Krishnamurti and Lim (2000) is as under:
Firstly, price relatives over the long period of a scrip could be expressed by the product of price relatives over T shorter periods as below:

\[ \frac{P_t}{P_0} = \frac{P_1}{P_0} \times \frac{P_2}{P_1} \times \ldots \times \frac{P_T}{P_{T-1}} \]

Taking logarithm in both sides we get:

\[ \ln P_t - \ln P_0 = (\ln P_1 - \ln P_0) + (\ln P_2 - \ln P_1) + \ldots + (\ln P_T - \ln P_{T-1}) \]

or, \[ R_L = \sum R_{s,t} \]

Where, \( R_L \) is the long period logarithmic return and \( R_{s,t} \) is the short period logarithmic return. Where, long period refers to a span of two days and short period means a span of half an hour. Therefore, for every two trading days, there would be one \( R_L \) and 24 \( R_{s,t} \).

Secondly, volatilities in terms of variances are computed. Which are \( \text{Var}(R_L) \) and \( \text{Var}(R_{s,t}) \) respectively. Hasbrouck and Schwartz (1987) show that in the absence of execution costs and presence of efficient markets, the implied variance of half an hour returns, \( \text{Var}(R_{s,t}) \), would be given by \( \text{Var}(R_L)/24 \).

Therefore, \[ MEC = \frac{\text{Implied Volatility}}{\text{Observed Volatility}} \]

\[ = \frac{\text{Var}(R_{s,t})}{\text{Var}(R_L)} \]

\[ = \frac{\text{Var}(R_{s,t})}{24} \]

Higher the MEC higher is the liquidity.
b) Adverse Selection Cost

Admati and Pfleiderer (1988) have developed the method named Adverse Selection Costs of transaction as a measure of liquidity. Adverse selection is measured in terms of the log of the ratio of the increase of market depth to price:

\[
\log \lambda = \log \left[ \frac{\sqrt{n} \cdot \text{var}(\mu)}{n+1} \cdot \text{var}(z) \right]
\]

Where, var(z) is the variance of the orders from noise traders, var(\mu) is the variance of final pay off and n is the number of risk neutral traders.

c) Turnover Ratio

Turnover Ratio of the following form is widely used as the measurement of market liquidity.

\[
\text{Turnover Ratio} = \frac{\text{Turnover for a period}}{\text{Market Capitalisation for that period}} \times 100
\]

Datar et al (1998), Garcia et al (1999), Orman (2003), Levine and Zervos (1998) etc. have used this measure in their respective studies. Higher the above ratio higher is the liquidity.

d) Impact Cost

Recently, Impact Cost is being used as a measure of liquidity in the NSE. The calculation of this measure consists of the following steps:

Firstly, from the order book average price of unmatched orders is computed.

Secondly, ideal price of the following form is derived:

\[
\frac{(\text{Best Bid Price} + \text{Best Ask Price})}{2}
\]

Finally, the percentage difference between the average price and the ideal price is computed which is called the impact cost. Lower the impact cost higher is the liquidity.
e) Coefficient of Elasticity of Trading (CET)

It may be defined as the sensitivity of the volume to changes in the price of a security. Symbolically this may be shown as:

\[ \text{CET} = \frac{\% \text{ change in trading volume}}{\% \text{ change in price}} \]

When large sized transactions take place with little or no change in price, value of CET tends to infinity indicating high liquidity.

f) Quote Slope

Quote slope is calculated by taking the ratio of spread and the log depth.

Symbolically, \( QS_t = \frac{Sabs_t}{D\ln_t} \)

\[ = \frac{p^s_t - p^b_t}{\ln(q^s_t) + (q^b_t)} \]

This measure has been used in the study conducted by Hasbrouck and Seppi (2001). A high quote slope denotes low liquidity.

g) Amivest Liquidity Ratio

This ratio combines turnover and return. It may be defined as the ratio between turnover and the absolute value of return at the period \( t \).

Symbolically, \( \frac{\text{Amivest Liquidity Ratio}}{} = \frac{\text{Turnover}_t}{|\text{Return}_t|} \)

Higher the ratio higher is the liquidity. If return in a certain period is zero then the ratio is taken as zero.

A variant of this ratio is \( \frac{|\text{Return}_t|}{\text{Number of Trade}_t} \)

If number of trade in a certain period is zero then the ratio is taken as zero.
4.4. Correlation and Substitutability among the Different Measures of Liquidity

In the previous sections of this chapter a number of liquidity measures have been described. There are instances in the related literature that use of different measures leads to different results. For example Brennan and Subrahmanyam (1996) observe that the use of any spread related measure offers a negative risk-illiquidity relationship. Conversely, an opposite result may be found by using other liquidity measures. Baker (1996) also reports some contradictory results in his study while working with different measures. This leads to investigate whether different measures of liquidity could be used interchangeably or not. In this section in order to accomplish the objective of examining the degree of association among those selected measures, the technique of rank correlation has been applied. For conducting this study monthly data of 35 scrips from 5 industries which are traded in the BSE have been selected. Selection of the companies has been influenced by the availability of the relevant information in the Capitaline data base. Thus, for every scrip we have 11 years' (January 1995 to December 2005) i.e., (11*12) or 132 data points which are considered long enough to draw a conclusion. From these data four liquidity measures have been calculated. These measures are CET, Number of Trades for the Month of t (NOTR), Turnover Ratio (TORAT) and the Amivest Liquidity Ratio (AMI). Next, Spearman's Rank Correlation of the following form has been calculated among these measures:

\[ \rho = 1 - \frac{6\sum d^2}{n(n^2 - 1)} \]

Where, \( d \) represents the difference of the ranks assigned by various measures. The Rank Correlation Coefficient (a number between -1 and +1) acts as an indicator
of the degree of association and in other words, the substitutability among the measures.

High values of the coefficients may indicate that the measures can be used interchangeably.

The correlation has been tested by using usual t test. The results are reported in Table 4.1.

Table 4.1. Rank Correlation Coefficients Among Various Liquidity Measures.

<table>
<thead>
<tr>
<th>SL. No</th>
<th>Name of the Company</th>
<th>CET Vs NOTR</th>
<th>CET Vs TORAT</th>
<th>CET Vs AMI</th>
<th>TORAT Vs AMI</th>
<th>TORAT Vs NOTR</th>
<th>AMI Vs NOTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Jindal Iron &amp; Steel Company</td>
<td>0.234**</td>
<td>0.210**</td>
<td>0.227**</td>
<td>0.885*</td>
<td>0.972*</td>
<td>0.872*</td>
</tr>
<tr>
<td>2.</td>
<td>TISCO</td>
<td>0.084</td>
<td>0.087</td>
<td>0.210**</td>
<td>0.646*</td>
<td>0.810*</td>
<td>0.544*</td>
</tr>
<tr>
<td>3.</td>
<td>Mahindra Ugine Steel Company Ltd.</td>
<td>0.129</td>
<td>0.121</td>
<td>0.106</td>
<td>0.862*</td>
<td>0.944*</td>
<td>0.822*</td>
</tr>
<tr>
<td>4.</td>
<td>SAIL</td>
<td>0.068</td>
<td>0.065</td>
<td>-0.051</td>
<td>0.869*</td>
<td>0.972*</td>
<td>0.849*</td>
</tr>
<tr>
<td>5.</td>
<td>Usha Martin Ltd.</td>
<td>0.034</td>
<td>-0.057</td>
<td>-0.006</td>
<td>0.817*</td>
<td>0.841*</td>
<td>0.738*</td>
</tr>
<tr>
<td>6.</td>
<td>Essar Steel Ltd.</td>
<td>0.137</td>
<td>0.106</td>
<td>0.062</td>
<td>0.867*</td>
<td>0.970*</td>
<td>0.853*</td>
</tr>
<tr>
<td>7.</td>
<td>Maharashtra Seamless Ltd</td>
<td>0.052</td>
<td>0.077</td>
<td>0.127</td>
<td>0.737*</td>
<td>0.903*</td>
<td>0.637*</td>
</tr>
<tr>
<td>8.</td>
<td>Chettinad Cement Corporation</td>
<td>0.0128</td>
<td>-0.076</td>
<td>-0.042</td>
<td>0.551*</td>
<td>0.367*</td>
<td>0.455*</td>
</tr>
<tr>
<td>9.</td>
<td>Dalmia Cement (Bharat) Ltd.</td>
<td>-0.052</td>
<td>0.050</td>
<td>0.074</td>
<td>0.784*</td>
<td>0.651*</td>
<td>0.589*</td>
</tr>
<tr>
<td>10.</td>
<td>Deccan Cement Ltd.</td>
<td>0.117</td>
<td>0.095</td>
<td>0.160</td>
<td>0.825*</td>
<td>0.900*</td>
<td>0.771*</td>
</tr>
<tr>
<td>11.</td>
<td>India Cements</td>
<td>0.192</td>
<td>0.153</td>
<td>0.160</td>
<td>0.852*</td>
<td>0.953*</td>
<td>0.808*</td>
</tr>
<tr>
<td>12.</td>
<td>Madras Cement</td>
<td>0.007</td>
<td>-0.079</td>
<td>0.110</td>
<td>0.620*</td>
<td>0.672*</td>
<td>0.475*</td>
</tr>
<tr>
<td>13.</td>
<td>Sagar Cement</td>
<td>-0.074</td>
<td>-0.093</td>
<td>-0.240</td>
<td>0.691*</td>
<td>0.930*</td>
<td>0.643*</td>
</tr>
<tr>
<td>14.</td>
<td>ACC</td>
<td>0.039</td>
<td>0.046</td>
<td>0.031</td>
<td>0.638*</td>
<td>0.769*</td>
<td>0.623*</td>
</tr>
<tr>
<td>15.</td>
<td>Hindustan Motors Ltd.</td>
<td>0.110</td>
<td>0.143</td>
<td>0.042</td>
<td>0.861*</td>
<td>0.970*</td>
<td>0.848*</td>
</tr>
</tbody>
</table>

(Contd …)
<table>
<thead>
<tr>
<th>SL. No</th>
<th>Name of the Company</th>
<th>CET Vs NOTR</th>
<th>CET Vs TORAT</th>
<th>CET Vs AMI</th>
<th>TORAT Vs NOTR</th>
<th>TORAT Vs AMI</th>
<th>AMI Vs NOTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Premier Automobiles Ltd.</td>
<td>0.105</td>
<td>0.120</td>
<td>0.230</td>
<td>0.783*</td>
<td>0.922*</td>
<td>0.680*</td>
</tr>
<tr>
<td>17</td>
<td>Ashok Leyland Ltd.</td>
<td>0.036</td>
<td>0.0564</td>
<td>0.014</td>
<td>0.743*</td>
<td>0.863*</td>
<td>0.694*</td>
</tr>
<tr>
<td>18</td>
<td>Eicher Motors Ltd.</td>
<td>0.034</td>
<td>0.036</td>
<td>0.055</td>
<td>0.722*</td>
<td>0.880*</td>
<td>0.709*</td>
</tr>
<tr>
<td>19</td>
<td>TATA Motors Ltd.</td>
<td>0.237**</td>
<td>0.252**</td>
<td>0.106</td>
<td>0.677*</td>
<td>0.875*</td>
<td>0.667*</td>
</tr>
<tr>
<td>20</td>
<td>Hero Honda Motors Ltd.</td>
<td>-0.075</td>
<td>-0.117</td>
<td>-0.033</td>
<td>0.618*</td>
<td>0.749*</td>
<td>0.620*</td>
</tr>
<tr>
<td>21</td>
<td>Kinetic Engineering Ltd.</td>
<td>0.072</td>
<td>0.089</td>
<td>-0.023</td>
<td>0.712*</td>
<td>0.934*</td>
<td>0.694*</td>
</tr>
<tr>
<td>22</td>
<td>TATA Elxsi Ltd.</td>
<td>0.004</td>
<td>0.006</td>
<td>0.053</td>
<td>0.851*</td>
<td>0.978*</td>
<td>0.888*</td>
</tr>
<tr>
<td>23</td>
<td>H C L Infosystem Ltd.</td>
<td>0.184</td>
<td>0.144</td>
<td>0.157</td>
<td>0.889*</td>
<td>0.968*</td>
<td>0.888*</td>
</tr>
<tr>
<td>24</td>
<td>Moser Baer (India ) Ltd.</td>
<td>-0.147</td>
<td>0.012</td>
<td>-0.149</td>
<td>0.729</td>
<td>0.820*</td>
<td>0.808*</td>
</tr>
<tr>
<td>25</td>
<td>TATA Infotech Ltd.</td>
<td>0.129</td>
<td>0.029</td>
<td>-0.035</td>
<td>0.815*</td>
<td>0.898*</td>
<td>0.755*</td>
</tr>
<tr>
<td>26</td>
<td>Infosys Technologies Ltd.</td>
<td>0.113</td>
<td>-0.048</td>
<td>-0.136</td>
<td>0.774*</td>
<td>0.916*</td>
<td>0.743*</td>
</tr>
<tr>
<td>27</td>
<td>Satyam Computer Services Ltd.</td>
<td>0.018</td>
<td>0.079</td>
<td>0.004</td>
<td>0.739*</td>
<td>0.664*</td>
<td>0.655*</td>
</tr>
<tr>
<td>28</td>
<td>Wipro Ltd.</td>
<td>-0.1676</td>
<td>-0.172</td>
<td>-0.055</td>
<td>0.857*</td>
<td>0.983*</td>
<td>0.855*</td>
</tr>
<tr>
<td>29</td>
<td>ABS</td>
<td>0.111</td>
<td>0.074</td>
<td>0.153</td>
<td>0.837</td>
<td>0.908*</td>
<td>0.756*</td>
</tr>
<tr>
<td>30</td>
<td>Castrol India Ltd.</td>
<td>-0.0249</td>
<td>-0.054</td>
<td>-0.182</td>
<td>0.757*</td>
<td>0.920*</td>
<td>0.715*</td>
</tr>
<tr>
<td>31</td>
<td>Chemplast Sanmar Ltd.</td>
<td>-0.062</td>
<td>-0.113</td>
<td>-0.089</td>
<td>0.832*</td>
<td>0.796*</td>
<td>0.720*</td>
</tr>
<tr>
<td>32</td>
<td>D C W Ltd.</td>
<td>0.163</td>
<td>-0.033</td>
<td>-0.032</td>
<td>0.833*</td>
<td>0.825*</td>
<td>0.709*</td>
</tr>
<tr>
<td>33</td>
<td>Finolex Industries Ltd.</td>
<td>0.187</td>
<td>0.153</td>
<td>0.229**</td>
<td>0.738*</td>
<td>0.886*</td>
<td>0.672*</td>
</tr>
<tr>
<td>34</td>
<td>Indian Petrochemicals Corporation Ltd.</td>
<td>0.044</td>
<td>0.967*</td>
<td>0.044</td>
<td>0.601*</td>
<td>0.871*</td>
<td>0.611*</td>
</tr>
<tr>
<td>35</td>
<td>Jubilliant Organosys Ltd.</td>
<td>0.146</td>
<td>0.074</td>
<td>0.193</td>
<td>0.741*</td>
<td>0.849*</td>
<td>0.673*</td>
</tr>
</tbody>
</table>

Sig. at 1% level ** Sig. at 5% level
Table 4.2. Frequency of Rank Correlation among Measures of Liquidity

<table>
<thead>
<tr>
<th>Degree of Correlation</th>
<th>Substitutability</th>
<th>Number of Observations</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 80%</td>
<td>Strong</td>
<td>54</td>
<td>26</td>
</tr>
<tr>
<td>65% to 79%</td>
<td>Moderate</td>
<td>34</td>
<td>16</td>
</tr>
<tr>
<td>50% to 64%</td>
<td>Weak</td>
<td>15</td>
<td>07</td>
</tr>
<tr>
<td>Less than 50%</td>
<td>None</td>
<td>107</td>
<td>51</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>210</td>
<td>100</td>
</tr>
</tbody>
</table>

For example coefficient between CET and NOTR in case of Jindal Iron & Steel Company is 0.234. This indicates that if we assign rank according to CET and repeat it according to NOTR, the chance that both the measures will give the same rank is 23.40%.

From Table 4.1 it is found that degree of association between –

i) CET and NOTR ranges from -0.1676 to .237.

ii) TORA and NOTR ranges from .367 to .983

iii) CET and TORA ranges from -0.172 to .252

iv) CET and AMI ranges from -0.240 to .230

v) AMI and NOTR ranges from .455 to .888

vi) AMI and TORA ranges from .551 to .983

In Table 4.2 the number of correlations under various groups has been reported. Here the grouping has been done on the basis of the degree of association. It also reveals substitutability measured in terms of rank correlation coefficients.

From this table it appears that out of 210 coefficients only 54 appears to have strong substitutability. In those cases one liquidity measure could be substituted by...
the other relevant proxy. Thus, only 26% of the observed relationships between measures show high degree of association. On the contrary in 50% or above cases very small or insignificant correlations among the proxies of liquidity are found.

4.5. Selection of Appropriate Measure of Liquidity for the Present Study

Any study on emerging capital markets suffers from one common problem which centers around the availability of the required data. This study is not an exception to that. The scope of the study is, thus being restricted to a certain. Many measures, particularly spread and depth related measures could not be computed due to non availability of time series data. Calculation of Impact Cost has not been made, especially for BSE, is due to the same reason although to some extent the Impact Cost data is available for NSE.

The present study does not use Number of Trades as a measure of liquidity as it is a one dimensional measure. CET is also not been considered as only in few cases it has a significant relationship with other measures.

Present study, is therefore, takes two popularly used measures of liquidity the Turnover Ratio and the Amivest Liquidity Ratio. Since, the results of this chapter reveal that there exists a strong positive correlation between these to measures, hence it is expected that these two measures could be used interchangeably without any contradictory results. For simplicity, while conducting the index level analysis Amivest Liquidity Ratio will be adjusted by multiplying \( \frac{1}{10^4} \) and the same will be multiplied by \( \frac{1}{10^6} \) for facilitating the scrip level analysis.