Liquidity and the Business Cycle

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Topic: Equity Liquidity and the Macroeconomy

This paper:
Investigate links
▶ Equity Market Liquidity
▶ Macroeconomy — i.e. Business Cycle.

We
▶ Show: Strong empirical link between (aggregate) stock market liquidity and the business cycle.
▶ Speculate: Are expectations about business cycle (consumption, investment) leading to portfolio rebalancing of individual investors?
▶ Show: Portfolio rebalancing of equity portfolios consistent with such a story.
Overview of presentation

- Equity market liquidity
  - What is it?
  - How to measure it?
- Why should liquidity vary?
  - be related to the macroeconomy?
- What markets are we looking at?
- What is the relationship?
  - Multivariate VARs
- Possible mechanism:
  - Rebalancing of individual investor portfolios.
- Evidence on portfolio rebalancing.
- Conclusion
Defining liquidity

Maureen O’Hara: “..a liquid market is one in which buyers and sellers can trade into and out of positions quickly and without having large price effects.”

Harris [2002], four interrelated liquidity dimensions:

- **depth** - the volume that can be traded
- **width** - the difference between the fundamental price and the transaction price
- **immediacy** - the speed of trade execution
- **resiliency** - how fast does the price move back to equilibrium after a large liquidity trade
Literature on liquidity

Starting point: Market Microstructure

- Implications of asymmetric information for price formation of single asset (stock)
  This literature - do not aggregate
  (Unless degree of asymmetric information varies)

Evolving microstructure literature:

- Broader implications – Asset pricing
- Common variation in (time series) of liquidity across
  - stocks [e.g. Chordia, Roll, and Subrahmanyam [2000], Hasbrouck and Seppi [2001], Huberman and Halka [2001]]
  - markets [e.g. Brockman, Chung and Pérignon (2006)]
  - liquidity measures [e.g. Korajczyk and Sadka [2007], Chollete, Naes, and Skjeltorp [2007, 2008]]
Time series variation in aggregate liquidity

Asset pricing implications

- commonality → systematic (non diversifiable) risk factor
- empirical support for a liquidity risk premium [e.g. Pastor and Stambaugh [2003], Acharya and Pedersen [2005]...]

But:
Why should we observe common variation in market liquidity?

Theoretical models with endogenous market liquidity

- Eisfeldt [2004]
  - market liquidity determined as a function of productivity
  - risky assets more attractive when productivity is high
- Gallmeyer, Hollifield, and Seppi [2008]: Demand Discovery, Saar [2006]
  - uncertainty about investors preferences and portfolios
  - link time variation in liquidity to equity risk premium
Relevant empirics

Typical empirical question:

- Do shocks to macroeconomic variables affect liquidity of financial markets?

Scandinavia: Söderberg [2008]

- monetary shocks (federal funds rate) forecast equity market liquidity
- no effect from shocks in real variables

In this paper:

- Ask the opposite question
  - Are there effects from liquidity to macroeconomic variables?
Measuring liquidity

Liquidity – “Soft” concept
→ Many empirical measures, aspects of liquidity.
We use three such measures:

Transaction cost measures

▷ Relative spread: \( RS = \frac{p_{ask} - p_{bid}}{(p_{ask} + p_{bid})/2} \)
▷ Lesmond/Ogden/Trzcinka [1999] measure (LOT)
  ▷ implicit cost required for a firm’s price to not move when the market moves
  ▷ do not require ask/bid prices for estimation

Price impact

▷ Amihud [2002] illiquidity ratio: \( ILR = |r|/VOLUME \)
  ▷ How much does one unit of trade move the price?

Market-wide liquidity

→ cross sectional averages of these liquidity measures
Data

**Norway 1980–2007**
- daily data, all listed securities at the Oslo Stock Exchange over the period 1980-2007 (OBI)
- close prices/returns, trading volume, bid/ask prices
- 100 listed companies in 1980, 260 listed companies in 2007

**USA 1980–2007**
- daily data, all listed securities in the US (NYSE, AMEX, NASDAQ) 1980-2007 (CRSP)
- close prices/returns, trading volume
- 2400 listed companies in 1980, 5900 listed companies in 2007
Indicative: Does liquidity and macro covary? – USA

US - Unemployment rate, NBER recessions and illiquidity

▶ Note: liquidity observed in real-time, macro variables with delay
Indicative: Does liquidity and macro covary? – Norway

Output gap, unemployment rate and relative spread (1980-2007)
Formal investigation – Vector Autoregressions

Unrestricted bivariate VARs

\[
\begin{bmatrix}
y_t \\
x_t
\end{bmatrix} = \begin{bmatrix} c_y \\
c_x
\end{bmatrix} + \begin{bmatrix} A_{1,1} & A_{1,2} \\
A_{2,1} & A_{2,2}
\end{bmatrix} \begin{bmatrix} y_{t-1} \\
x_{t-1}
\end{bmatrix} + \begin{bmatrix} \epsilon^y_t \\
\epsilon^x_t
\end{bmatrix}
\]

- Macro variables (\(y\)): GDP, unemployment, consumption
- Liquidity proxy (\(x\)) for Norway: Relative bid/ask spread (\(RS\))
- Liquidity proxy (\(x\)) for US: Illiquidity ratio (\(ILR\))
- Perform Granger causality tests between \(x\) and \(y\)
## Norway - Liquidity, unemployment and GDP growth

### (a) Unemployment and spread

<table>
<thead>
<tr>
<th></th>
<th>$d_{UE_t}$</th>
<th>$RS_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constant</strong></td>
<td>-0.577**</td>
<td>0.006**</td>
</tr>
<tr>
<td></td>
<td>[-4.33]</td>
<td>[2.59]</td>
</tr>
<tr>
<td>$d_{UE_{t-1}}$</td>
<td>-0.170</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>[-1.80]</td>
<td>[-0.55]</td>
</tr>
<tr>
<td>$RS_{t-1}$</td>
<td>14.380**</td>
<td>0.846**</td>
</tr>
<tr>
<td></td>
<td>[4.55]</td>
<td>[14.93]</td>
</tr>
</tbody>
</table>

**Granger causality tests:**

<table>
<thead>
<tr>
<th></th>
<th>Chi-sq</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0: $d_{UE} \rightarrow RS$</td>
<td>0.31</td>
<td>0.58</td>
</tr>
<tr>
<td>H0: $RS \rightarrow d_{UE}$</td>
<td>20.79**</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### (b) GDP growth and spread

<table>
<thead>
<tr>
<th></th>
<th>$d_{GDP_t}$</th>
<th>$RS_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constant</strong></td>
<td>0.023**</td>
<td>0.007**</td>
</tr>
<tr>
<td></td>
<td>[5.67]</td>
<td>[2.94]</td>
</tr>
<tr>
<td>$d_{GDP_{t-1}}$</td>
<td>-0.410**</td>
<td>-0.037</td>
</tr>
<tr>
<td></td>
<td>[-4.57]</td>
<td>[-0.68]</td>
</tr>
<tr>
<td>$RS_{t-1}$</td>
<td>-0.373**</td>
<td>0.825**</td>
</tr>
<tr>
<td></td>
<td>[-3.99]</td>
<td>[14.71]</td>
</tr>
</tbody>
</table>

**Granger causality tests:**

<table>
<thead>
<tr>
<th></th>
<th>Chi-sq.</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0: $d_{GDP} \rightarrow RS$</td>
<td>0.46</td>
<td>0.49</td>
</tr>
<tr>
<td>H0: $RS \rightarrow d_{GDP}$</td>
<td>15.99**</td>
<td>0.00</td>
</tr>
</tbody>
</table>
# US results - Liquidity and GDP growth

## US GDP growth and illiquidity (ILR)

<table>
<thead>
<tr>
<th></th>
<th>All US stocks</th>
<th>NYSE stocks</th>
<th>NASDAQ stocks</th>
<th>AMEX stocks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>dGDP&lt;sub&gt;t&lt;/sub&gt;</td>
<td>ILR&lt;sub&gt;t&lt;/sub&gt;</td>
<td>dGDP&lt;sub&gt;t&lt;/sub&gt;</td>
<td>ILR&lt;sub&gt;t&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>Const.</strong></td>
<td>0.01</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>[6.96]</td>
<td>[ 0.28]</td>
<td>[ 7.16]</td>
<td>[ 0.14]</td>
</tr>
<tr>
<td><strong>dGDP&lt;sub&gt;t-1&lt;/sub&gt;</strong></td>
<td>0.30</td>
<td>0.00</td>
<td>0.30</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>[ 3.29]</td>
<td>[-0.59]</td>
<td>[ 3.44]</td>
<td>[-0.55]</td>
</tr>
<tr>
<td><strong>ILR&lt;sub&gt;t-1&lt;/sub&gt;</strong></td>
<td>-7.94</td>
<td>0.62</td>
<td>-38.37</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td>[-2.81]</td>
<td>[ 8.64]</td>
<td>[-3.34]</td>
<td>[ 6.96]</td>
</tr>
<tr>
<td><strong>R&lt;sup&gt;2&lt;/sup&gt;</strong></td>
<td>0.22</td>
<td>0.46</td>
<td>0.24</td>
<td>0.35</td>
</tr>
</tbody>
</table>

### Causality tests:

<table>
<thead>
<tr>
<th></th>
<th><strong>χ&lt;sup&gt;2&lt;/sup&gt;</strong></th>
<th>p-val</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>dGDP → ILR</strong></td>
<td>0.34</td>
<td>0.56</td>
</tr>
<tr>
<td><strong>ILR → dGDP</strong></td>
<td>7.92</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Possible causal mechanism

Theory:

- Demand discovery [Gallmeyer et al., 2008]:
  Trading in equity markets (portfolio rebalancing) reflect changes in expectations of real economy (Consumption needs, liquidity necessary for hedging)

Particularly:

“Flight to liquidity” in economic downturns

→ Least liquid stocks most sensitive to changes in business cycle
→ Investors portfolios rebalanced, move out of the least liquid stocks.
Can we find evidence of such a “flight to liquidity”?

Show two empirical observations consistent with such a story.

1. Link between equity market liquidity and business cycle strongest for small firms (least liquid stocks).
2. Portfolio rebalancing in equity portfolios: Move away from small stocks.
Small firms strongest link liquidity — business cycle...

Norway: Output gap, relative spread
Small firms strongest link liquidity — business cycle...

**VARs: Unemployment and liquidity of small and large firms**

**Norway**

<table>
<thead>
<tr>
<th>Granger causality tests:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H0: dUE $\rightarrow$ RS$^{small}$</td>
<td>Chi-sq 0.004</td>
</tr>
<tr>
<td>H0: dUE $\rightarrow$ RS$^{large}$</td>
<td>Chi-sq 0.201</td>
</tr>
<tr>
<td>H0: RS$^{small}$ $\rightarrow$ dUE</td>
<td><strong>Chi-sq 9.283</strong>, p-value <strong>0.000</strong></td>
</tr>
<tr>
<td>H0: RS$^{large}$ $\rightarrow$ dUE</td>
<td>Chi-sq 0.526</td>
</tr>
</tbody>
</table>

**US (all stocks)**

<table>
<thead>
<tr>
<th>Granger causality tests:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H0: dUE $\rightarrow$ ILR$^{small}$</td>
<td>Chi-sq 1.80</td>
</tr>
<tr>
<td>H0: dUE $\rightarrow$ ILR$^{large}$</td>
<td>Chi-sq 0.61</td>
</tr>
<tr>
<td>H0: ILR$^{small}$ $\rightarrow$ dUE</td>
<td><strong>Chi-sq 20.65</strong>, p-value <strong>0.000</strong></td>
</tr>
<tr>
<td>H0: ILR$^{large}$ $\rightarrow$ dUE</td>
<td>Chi-sq 0.23</td>
</tr>
</tbody>
</table>
Changes in investor portfolio compositions

Norway – Data from VPS – Portfolios of individual investors. Ask: Is liquidity variation related to investor participation? Monthly ownership data (VPS) for all owners in all listed companies (1993-2007)

- share holdings of all investors
- investor types (individuals, foreigners/domestic, state, financials, non-financials)

Construct a simple participation measure

- \( N(\text{investors that enter}) - N(\text{investors that leave}) \)
- correlation between liquidity and participation
- for all firms, across firm sizes
Changes in investor portfolio compositions ctd.

Correlation between liquidity and change in participation

<table>
<thead>
<tr>
<th>Quarterly</th>
<th>All firms</th>
<th>Firm size quartiles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Q1 (small)</td>
</tr>
<tr>
<td>All owners</td>
<td>-0.07</td>
<td>-0.35**</td>
</tr>
<tr>
<td>Personal</td>
<td>-0.02</td>
<td>-0.33**</td>
</tr>
<tr>
<td>Foreign</td>
<td>-0.18</td>
<td>-0.30**</td>
</tr>
<tr>
<td>Financial</td>
<td>-0.06</td>
<td>-0.11</td>
</tr>
<tr>
<td>Nonfinancial</td>
<td>-0.16</td>
<td>-0.35**</td>
</tr>
<tr>
<td>State</td>
<td>-0.06</td>
<td>-0.20</td>
</tr>
</tbody>
</table>

- high spreads (low liquidity) ⇔ lower participation
- stronger correlation for smallest firms
Summary of main results

Strong relation between equity market-liquidity and economic activity

- equity market liquidity contains information about current and future macro fundamentals
- mainly reflected in the liquidity of small firms

Variation in market liquidity related to changes in equity portfolio composition

- liquidity worsens simultaneously with investors moving out of small stocks
Planned work..

⇒ additional markets
  ▶ currently started to look at Japan, Australia, UK, Sweden

⇒ forecasting/“nowcasting”
  ▶ which liquidity measure has the best/most robust forecasting performance
  ▶ common liquidity factor à la Chollete/Næs/Skjeltorp(’07,’08)


Jonas Söderberg. Do macroeconomic variables forecast changes in liquidity? an out-of-sample study on the order-driven stock