Does Funding Liquidity Cause Market Liquidity? 
Evidence from a Quasi-experiment

Petri Jylha
Imperial College London
Does funding liquidity cause market liquidity?
   – YES!

Agenda

• Motivation of research question
• Research methodology
• Empirical results
• Conclusions
Funding liquidity and market liquidity

Assets
Financial securities

Liabilities
Debt
Equity

Market liquidity
Ease at which securities are traded

Funding liquidity
Ease at which traders obtain funding
• Gromb & Vayanos (2002, JFE) and Brunnermeier & Pedersen (2009, RFS)
• Funding constraints (insufficient funding liquidity) prevent traders from providing full liquidity to financial markets
• Improvement in funding liquidity $\rightarrow$ increase in traders’ positions $\rightarrow$ improvement in market liquidity
• Causal effect of funding liquidity on market liquidity
1) “Buy 1m NL shares”

Royal Dutch Shell

€25 = £18

2) Liquidity provider buys 1m UK shares @ £18 and sells 1m NL shares @ €25

No funding constraints
Perfect funding liquidity
1) "Buy 1m NL shares"

Royal Dutch Shell

€25 = £18

2) Liquidity provider buys 0.5m UK shares @ £18 and sells 0.5m NL shares @ €25

Some funding constraints
Imperfect funding liquidity

€26 ≠ £18
• Causal effect of funding liquidity on market liquidity
• Difficult to test
  – Measuring funding liquidity difficult
  – Correlation ≠ causation
  – Common determinant
  – Direction of causality
• Solution
  – Find exogenous funding liquidity shock
  – Measure market liquidity effect of this funding liquidity shock
Funding liquidity shock

- Approval of “portfolio margining” of listed index options by SEC on July 14, 2005
- Significant reduction of margin requirement (improvement in funding liquidity) for index options
- No effect on margin requirement for (single-name) equity options
• Individual written option
  – Call: $C_t + 0.15 \times S_t + \max(S_t - K, 0)$
  – Put: $P_t + 0.15 \times S_t + \max(K - S_t, 0)$

• Pre-determined strategies (straddle, box spread, collar, ...)
  – Some combination of components (e.g. maximum)
  – Similar formula

• Problem
  – OTM options especially expensive to write
  – Limited number of pre-determined strategies
  – High margin requirement for complex low-risk portfolios
  – Ignores mechanical correlations
Margining of written options
Portfolio margin

- Based on portfolio scenario analysis
- Shock underlying asset
  - -8%,...,+6% for index underlying
  - -15%,...,+15% for stock underlying
- Calculate total portfolio P&L for each scenario
- Margin requirement = maximum portfolio loss
- For index option portfolios, portfolio margin is on average 28% of strategy-based margin
- Significant improvement in funding liquidity
- Fully incorporates mechanical correlations
• Price of underlying $1451
• Write 1425-put @ $11.66 and 1500-call @ $5.96
• Margins
  – Separately: $19.15 (put) + $16.89 (call) = $36.04
  – Strategy-based: $19.15
  – Portfolio: $6.70
    • 35% of strategy-based margin
Identification strategy

- Analyse option liquidity around portfolio marging approval
- Compare changes in index option liquidity to changes in equity option liquidity
- Equity options provide control (placebo) group to eliminate effect of market-wide liquidity changes
$Liq_{i,t} = \beta_0 + \beta_1 \times Index_i \times After_t + \beta_2 \times Index_i + \beta_3 \times After_t$

- $Liq_{i,t}$: option liquidity measure for underlying $i$ on day $t$
- $Index_i$: 1 for index options and 0 for equity options
- $After_t$: 1 after 14/7/2005 and 0 before
**Regression setup**

\[ Liq_{i,t} = \beta_0 + \beta_1 \times Index_i \times After_t + \beta_2 \times Index_i + \beta_3 \times After_t \]

### Average level of liquidity

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equity</strong></td>
<td>(\beta_0)</td>
<td>(\beta_0 + \beta_3)</td>
<td>(\beta_3)</td>
</tr>
<tr>
<td><strong>Index</strong></td>
<td>(\beta_0 + \beta_2)</td>
<td>(\beta_0 + \beta_1 + \beta_2 + \beta_3)</td>
<td>(\beta_1 + \beta_3)</td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td>(\beta_2)</td>
<td>(\beta_1 + \beta_2)</td>
<td>-</td>
</tr>
</tbody>
</table>

**Coefficient of interest**

Difference-in-difference
• Additional controls
  – Lagged implied volatility, lagged return of underlying, lagged squared return of underlying, last-day-of-trading (3rd Friday) dummy, time and underlying fixed effects

• Standard errors clustered by time
  – No two-way clustering as liquidity measures aggregated by underlying and day
• Daily option price data from OptionMetrics database
• Options traded on CBOE
• 5 index options (S&P 100 and 500, Dow Jones, Nasdaq 100, and Russell 2000)
• 30 most traded equity options
• 200-day estimation window around event
  – From 18/2/2005 to 2/12/2005
Liquidity measures

• Trading volume
• Bid-ask spread $\rightarrow$ direct trading cost
• Price impact $\rightarrow$ indirect trading cost
Effect on trading volume

- Contract volume ↑ 18 %
  - Effect comes mainly from OTM options

- Dollar volume ↑ 8 %
  - OTM options’ dollar volume ↑ 20 %

- Contract volume increase > dollar volume increase
  - Trading moves towards cheaper options
  - Moneyness of traded options ↓
  - More trading in previously illiquid OTM options
Effect on bid-ask spread

- Bid-ask spread ↓ 101bps
  - 12% of pre-event average (812bps)
  - Effect stronger for OTM options

- Significant reduction in direct trading costs
Effect on price impact

- Price impact answers question "How much option prices move from $1m of trading?"
- Price impact measures \( \downarrow 22\% - 33\% \)
- Significant reduction in indirect trading costs
Market efficiency

- Market liquidity improvement is nice, what about market efficiency?
- Difficult to measure changes in market efficiency over single event
- Solution: dispersion of option price implied volatility) changes for one underlying during one day
- Efficient markets: prices reflect fundamentals well → implied volatilities moe in tandem → dispersion low
- Inefficient markets: prices reflect fundamentals poorly → implied volatilities move by transitory supply/demand shocks → dispersion high
Effect on market efficiency

- Dispersion of implied volatility change ↓
  → Market efficiency ↑
- Effect stronger for OTM options
- Significant improvement in market efficiency
  – Especially for previously illiquid OTM options
• Funding liquidity improvement \( \rightarrow \) market liquidity and market efficiency improvements
  – Especially for illiquid securities
• Causal evidence in support of theories of Gromb & Vayanos (2002) and Brunnermeier & Pedersen (2009)
• Take-aways
  – Theories work
  – Margin regulation changes can be used to study effects of funding liquidity
  – Margin requirements have dark side: higher margin requirement results in less liquid and less efficient markets