THE TERM STRUCTURE OF BOND MARKET LIQUIDITY

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ON-the-Run vs OFF-the-Run

- Treasury market illiquidity literature focus: **on-the-run**

  - Differences between yields and spreads of T-bills and notes with less than 6 months to maturity – OFF-the-Run securities

- Illiquidity of OFF-the-Run issues is not studied
Short Run vs Long Run

  - Increasing the number of observations by sampling more frequently while leaving the span in years of data unchanged may not increase the power of tests.

- **Previous Literature uses short time span (7 years most):**

- **Our work - November 1967 to December 2005 – monthly data**
Illiquidity Differences Across Maturities

- Notes and Bills have different “quotation, trading and their quotes are transmitted on different systems. Traders usually specialize in one type of these government securities, and there are differences between the two markets” – Amihud and Mendelson 1991

- Flights into or out-of the bond market do not target specific maturity ranges. Beber, Brandt and Kavajecz (2006) - investors price the transaction cost component both when they enter and exit the bond market.

- Need to understand the structure of bond market liquidity

- Our work - three illiquidity ranges – short, medium and long + on-the-run and off-the-run (six economic variables)
Research Questions I

- Previous research (Brunnermeier and Pedersen, 2006, and Chordia, Roll, and Subrahmanyam, 2005) - macroeconomic variables and price volatility may impact bond market illiquidity by affecting market-making costs. Do such variables differentially impact on- and off-the-run market making costs, and in turn, illiquidity?

- Are bond returns forecastable from illiquidity levels, i.e., is there evidence of illiquidity premia in the bond market?

- How are illiquidity shocks transmitted in the bond market? Are they reflected first in the relatively less active off-the-run issues or the more active on-the-run ones?
Research Questions II

- **Cross-Market Effect:** If the illiquidity of certain bonds forecasts those of other bonds by reflecting illiquidity shocks first, then it may forecast returns not just in the own-market but in other markets as well.

- How does the predictive power of illiquidity for bond returns vary across maturity and off-the-run status?
Summary of Results: time series determinants

- For both off-the-run and on-the-run – bond spread (long-short) significantly widens during recessions – consistent with flight-to-quality and flight-to-liquidity
- For both off-the-run and on-the-run – Granger-causality goes from short-term to long-term (one direction only)
  - off-the-run short-term Granger causes on-the-run short-term (one direction only)
- On-the-run illiquidity is affected by volatility
- Off-the-run illiquidity is predicted by
  - inflation (short- and long-term)
  - monetary policy (all maturities)
  - returns and volatility
  - illiquidity of short-term bonds predicts illiquidity of long-term bonds
Results II: Illiquidity Premium

- VAR analysis indicates – on-the-run (short, medium and long) illiquidity has no effect on bond returns

- Short-term off-the-run illiquidity affects returns across all maturities

- Medium and long-term off-the-run illiquidity is not priced
Data

- Treasury market illiquidity – relative bid-ask spread (CRSP daily Treasury Quotes) from November 1967 to December 2005

- On-the-run – just issued, older securities are off-the-run
   - Short-term illiquidity – Tbilis with maturity less or equal to 1 year
   - Medium illiquidity – quotes of 2-to-5 year bonds
   - Long-term illiquidity – quotes of 10-year note

- Returns: short-term - the return on 3 month T-bill, medium and long are returns on 5- and 10-year notes (CRSP Treasury monthly file)
## Treasury Illiquidity

### Panel A. The whole sample

<table>
<thead>
<tr>
<th></th>
<th>On-the-run</th>
<th>Off-the-run</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bond-short</td>
<td>Bond-medium</td>
</tr>
<tr>
<td>Average</td>
<td>0.032</td>
<td>0.106</td>
</tr>
<tr>
<td>St. dev</td>
<td>0.026</td>
<td>0.147</td>
</tr>
<tr>
<td>Median</td>
<td>0.019</td>
<td>0.07</td>
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</table>

All numbers are multiplied by 100

### Panel B. Recessions (NBER)

<table>
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<tr>
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<th>On-the-run</th>
<th>Off-the-run</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bond-short</td>
<td>Bond-medium</td>
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<tr>
<td>Average</td>
<td>0.057</td>
<td>0.124</td>
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<tr>
<td>St. dev</td>
<td>0.03</td>
<td>0.102</td>
</tr>
<tr>
<td>Median</td>
<td>0.066</td>
<td>0.121</td>
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</table>
Off-the-Run Short-Term
Off-the-Run Long-Term
## Spread (long – short)

<table>
<thead>
<tr>
<th></th>
<th>On-the-run</th>
<th>Off-the-run</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bond-long – Bond-short</td>
<td>Bond-long – Bond-short</td>
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<tr>
<td>Whole sample</td>
<td>Whole sample</td>
<td>Whole sample</td>
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<tr>
<td>Recession</td>
<td>0.09</td>
<td>0.131</td>
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<tr>
<td>No recession</td>
<td>0.078</td>
<td>0.185</td>
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<tr>
<td>Diff.</td>
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<td>0.121</td>
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<tr>
<td>p-value</td>
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<td>0.00</td>
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</table>

**Flight-to-quality or flight-to-liquidity**
Granger-causality

<table>
<thead>
<tr>
<th></th>
<th>Bond-short</th>
<th>Bond-medium</th>
<th>Bond-long</th>
<th>Bond-short</th>
<th>Bond-medium</th>
<th>Bond-long</th>
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<td></td>
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<tr>
<td>Bond-short</td>
<td>11.34</td>
<td></td>
<td>5.28</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td></td>
<td>(0.022)</td>
<td></td>
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<td>Bond-medium</td>
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<td>0.01</td>
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<tr>
<td></td>
<td>(0.041)</td>
<td></td>
<td>(0.912)</td>
<td></td>
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<tr>
<td>Bond-long</td>
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<td></td>
<td>0.05</td>
<td>0.53</td>
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<td>6.44</td>
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<tr>
<td></td>
<td>(0.355)</td>
<td></td>
<td>(0.820)</td>
<td>(0.467)</td>
<td></td>
<td>(0.011)</td>
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<tr>
<td><strong>Off-the-run</strong></td>
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<tr>
<td>Bond-short</td>
<td>11.97</td>
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<td>8.46</td>
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<tr>
<td></td>
<td>(0.001)</td>
<td></td>
<td>(0.004)</td>
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<tr>
<td>Bond-medium</td>
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<td>0.00</td>
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<td></td>
<td>(0.791)</td>
<td></td>
<td>(0.960)</td>
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<tr>
<td>Bond-long</td>
<td>0.53</td>
<td></td>
<td>6.44</td>
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<tr>
<td></td>
<td>(0.467)</td>
<td></td>
<td>(0.011)</td>
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</table>

Illiquidity shocks are transmitted from the short end to the long end of term structure
## VAR innovations: Off-the-Run

<table>
<thead>
<tr>
<th></th>
<th>Volat</th>
<th>RET1</th>
<th>RET5</th>
<th>RET10</th>
<th>Bond-short</th>
<th>Bond-Medium</th>
<th>Bond-Long</th>
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<tbody>
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<td>Volat</td>
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<tr>
<td>RET1</td>
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<td>1.00</td>
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<tr>
<td>RET5</td>
<td>0.02</td>
<td>0.49</td>
<td>1.00</td>
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<tr>
<td>RET10</td>
<td>0.03</td>
<td>0.38</td>
<td>0.91</td>
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<tr>
<td>Bond-short</td>
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<td>-0.16</td>
<td>-0.18</td>
<td>-0.11</td>
<td>1.00</td>
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<tr>
<td>Bond-medium</td>
<td>0.02</td>
<td>0.01</td>
<td>0.02</td>
<td>0.07</td>
<td>-0.03</td>
<td>1.00</td>
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<tr>
<td>Bond-long</td>
<td>0.08</td>
<td>0.00</td>
<td>-0.14</td>
<td>-0.05</td>
<td>0.27</td>
<td>0.26</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Consistent with Amihud (2002) for the stock market

Control variables: Inflation, FED, DEF, TERM
Off-the-Run Bond-Short Illiquidity

- Impulse response of bond-short to
  - Bond-Long Shock
  - Bond-Medium Shock
  - Bond-Short Shock
Off-the-Run Bond-Long Illiquidity

- Impulse response of bond-long to

Illiquidity shocks are transmitted from the illiquidity of the short-end to the illiquidity of the long-end and not vice versa.
Illiquidity and Monetary Policy

- Monetary tightening

**Short-term off-the-run has the immediate and persistent response to FED**
Summary

- **On-the-Run** – less dynamics: positive shock to FED increases short-term illiquidity; shock to volatility increases illiquidity across all maturities
  - active trading in the on-the-run bonds shields market makers from increases in inventory and order processing costs due to inflation and tighter monetary policy

- **Off-the-Run** – more dynamics:
  - Inflation and FED increase illiquidity across different maturities
  - Volatility increases illiquidity (consistent with inventory risk (Ho and Stoll (1983) and O’Hara and Oldfield (1986))
  - Positive shocks to bond returns across different maturities decrease off-the-run bond illiquidity (consistent with Chordia, Roll, and Subrahmanyam (2001))
  - Illiquidity shocks are transmitted from the short-end to the long-end
Pricing Implications

- Response of T-bill returns to off-the-run illiquidity

Only contemporaneous associations for illiquidity

FED, Inflation and DEF have positive affect
Pricing Implications

- Response of 5-year bond returns to
  - Bond-Long Shock
    - Consistent with Amihud (2002)
  - Bond-Medium Shock
    - As in Fama and French (1993) TERM and DEF have an affect
  - Bond-Short Shock
Pricing Implications

- Response of 10-year bond returns to

  - Bond-Long Shock
  - Bond-Medium Shock
  - Bond-Short Shock

  Consistent with Amihud (2002)

As in Fama and French (1993) TERM and DEF have an affect.
Conclusion

- The source of illiquidity premium (Amihud and Mendelson 1991) in the Treasury market is illiquidity of short-term off-the-run issues

- Makes sense because:
  - On-the-run illiquidity is not priced and largely driven by volatility
  - For off-the-run illiquidity: illiquidity shocks are transferred from the illiquidity of the short-end to the illiquidity of the long-end
  - Short-term illiquidity predicts its own illiquidity and illiquidity of other maturities
  - Short-term illiquidity also predicts illiquidity premium across other maturities

- Dynamics of off-the-run illiquidity is richer: it is driven by inflation, monetary policy, bond returns and volatility (this information is eventually transmitted into the bond prices)