What drives liquidity?
Identifying shocks to market makers' supply of liquidity and their role in economic fluctuations

Jonathan Goldberg
Federal Reserve Board

Atlanta Liquidity Conference - November 20, 2015

1The views expressed are those of the author and do not indicate concurrence by the Federal Reserve Board of Governors or other research staff.
Motivation

After crisis, renewed interest in intermediaries’ risk-bearing capacity

But hard to identify shocks
  ▶ Supply and demand
  ▶ Endogeneity
This paper

Focus on broker-dealers and Treasury market
  ▶ Implications for supply of intermediation by dealer firms

What shocks drive market liquidity?
  ▶ Structural VAR with sign restrictions

Business cycles and asset prices
Dealers and market liquidity

Volatility episodes

- Quant ('07), Flash ('10), Taper Tantrum ('13)
- *Symptomatic* of liquidity drought?
Approach

Look for a price and a quantity of liquidity such that

1. dealer willingness ↑ implies

\[ P \downarrow Q \uparrow \]

2. macro shocks (TFP, uncertainty, markup, time pref, sentiment, monetary) do not imply

\[ P \downarrow Q \uparrow \] or vice versa

Theory model

Robustness: Control for broad financial conditions
Dealer intermediation

Maturity–Matched Positions
Gross long and short positions

01jan1990 01jan1995 01jan2000 01jan2005 01jan2010 01jan2015

Billions
01jan1990 01jan1995 01jan2000 01jan2005 01jan2010 01jan2015

Maturity–Matched Positions Gross long and short positions
Dealer intermediation
Dealer intermediation

\[ f(n) = \beta_0 + \beta_1 \exp\left( -\frac{n}{\tau_1} \right) + \beta_2 \left( \frac{n}{\tau_1} \right) \exp\left( -\frac{n}{\tau_1} \right) + \beta_3 \left( \frac{n}{\tau_2} \right) \exp\left( -\frac{n}{\tau_2} \right) \]
Theory: Overview

Noise compensates dealers for making markets

A investors, B investors

A bonds, B bonds: same maturity

Segmented: A investors trade only A bonds (GV 2002)

Dealers
Dealer intermediation

Segmented markets

- Client owns a bond and no longer wants rate risk; wants to sell, not short similar maturity
- Close out a short
- “price-insensitive insurance companies” (Pedersen 2015)
“P” = |p_b − p_a| and “Q” = gross long and short positions of the dealer

Dealer risk aversion ⇒ P ↑ Q ↓

Investor risk aversion ⇒ P ↑ Q ↑

Mean or variance of rates ⇒ no effect on P or Q
Model

\[ Y_t = b + ct + B_1 Y_{t-1} + B_2 Y_{t-2} + \ldots + B_l Y_{t-l} + \xi_t \]

\[ E \left[ \xi_t \xi_t' \right] = \Sigma \]

Find \( A \)

\[ A^{-1} \xi_t = v_t \]

where \( v_t \) mutually independent

\[ E \left[ v_t v_t' \right] = I_m \]

Model

\( Y_t \)

- Noise
- Aggregate gross long and short positions
- Equity-market implied vol (VIX)
- Equity excess returns \( (r_t^{mkt} - r_t^{rf}) \)
- Treasury market implied vol (MOVE)
## Identification

### Benchmark

<table>
<thead>
<tr>
<th></th>
<th>Supply</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Gross positions</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>VIX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity returns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOVE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Required to hold on impact and $K = 12$ more weeks
### Identification

**Alternative:** Controlling for rate risk and equity market shocks

<table>
<thead>
<tr>
<th></th>
<th>Supply</th>
<th>Demand</th>
<th>Rate risk</th>
<th>Equity market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>-</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross positions</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIX</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Equity returns</td>
<td></td>
<td></td>
<td></td>
<td>−</td>
</tr>
<tr>
<td>MOVE</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>

Required to hold on impact and $K = 12$ more weeks
IRFs: Liquidity supply shock

Gray: pointwise 68-percent credible interval
Model

IRFs: Liquidity supply shock - alternative specification

Gray: pointwise 68-percent credible interval
Cumulative sum of shocks

Liquidity Supply Shock

Cumulative effect on noise

- Effect of Liquidity Supply Shock only
- Effect of all shocks

Event: RTC, UK Currency Crisis, Fed rate hike, MEX Peso, Asia, LTCM, dotcom peak, WorldCom Bankruptcy, GM/Ford, LEH, First Greek bailout, Debt Ceiling, Taper tantrum

Percentage Change: -100 to 250
Cumulative effect on VIX

The diagram illustrates the cumulative effect on VIX over time, with various labeled shocks and events impacting market volatility. The x-axis represents years from 1991 to 2015, and the y-axis shows the percent change in VIX.

Key events and shocks include:
- RTC
- UK Currency Crisis
- Fed rate hike
- MEX Peso
- Asia
- LTCM
- dotcom peak
- WorldCom Bankruptcy
- GM/Ford
- LEH
- First Greek bailout
- Debt Ceiling
- Taper tantrum

The graph compares the effect of liquidity supply shock only to the effect of all shocks, highlighting significant spikes corresponding to major financial events.
Forecast error variance decomposition
Business cycles

\[ \Delta x_{tm} = \alpha_0 + \sum_{i=0}^{l} \theta_{s,i} v_{s,t_{m-i}} + \epsilon_{s,t_{m}} \]

\[ \rho(L)\epsilon_{s,t_{m}} = \zeta_{s,t} \sim i.i.d. \ N(0, h_{s}^{-1}) \]

Identification

- No feedback within a given month from \( \Delta x_{t_{m}} \) to \( v_{s,t_{m}} \)
Business cycles

Estimation

- Takes into account regressors are generated
- Unified Bayesian approach
Impulse responses to supply shock

Business cycles
Gray: pointwise 68-percent credible interval
Conclusion

New method for identifying shocks to the supply of intermediation by broker dealers

- Improves on previous methods including recursively identified VARs

Liquidity supply shocks have important effects on real activity, inflation, asset prices

Normative conclusions require macro models with financial sector

- Approach in this paper can potentially discipline models