Intraday Liquidity and Money Market Dislocations

Adrien d’Avernas
Stockholm School of Economics

Quentin Vandeweyer
Chicago Booth
Repo Spikes
Repo Spikes
Reserves Supply

Total Reserve Balances

$ bln


0 500 1,000 1,500 2,000 2,500 3,000 3,500
Average Peak Daylight Fed Overdrafts
Bank Repo Lending vs. Repo Spreads
Motivation

- Repo spikes remain a mystery.
  - Why the non-linearities?
  - Repo market is a core funding market for shadow banks

Motivation

- Repo spikes remain a mystery.
  - Why the non-linearities?
  - Repo market is a core funding market for shadow banks

- Explanations put forward point to intraday liquidity:

  “[W]e have $120 billion in our checking account at the Fed, and it goes down to $60 billion and then back to $120 billion during the average day. But we believe the requirement under CLAR and resolution and recovery is that we need enough in that account, so if there’s extreme stress during the course of the day, it doesn’t go below zero. If you go back to before the crisis, you’d go below zero all the time during the day. So the question is, how hard is that as a red line? That will be up to regulators to decide, but right now we have to meet those rules and we don’t want to violate what we told them we are going to do.”

This Paper

Research question: What drives money market dislocations?
This Paper

Research question: What drives money market dislocations?

Macro-banking model of the repo market with:

- repo market between banks and preferred habitat shadow banks
- transactions settled with reserves: intraday flows
- banks subject to intraday liquidity regulation
This Paper

Research question: What drives money market dislocations?

Macro-banking model of the repo market with:

- repo market between banks and preferred habitat shadow banks
- transactions settled with reserves: intraday flows
- banks subject to intraday liquidity regulation

Main findings:

- intraday liquidity requirements $\rightarrow$ inelastic kink in repo supply
- larger T-bonds-reserves balance $\rightarrow$ higher probability of repo spike
- higher spike probability $\rightarrow$ increase in T-bond spreads

$\Rightarrow$ consistent with empirical evidence on Treasury volumes and settlements, as well as September 2019 and March 2020 events
Model
Environment

- Discrete time with two sub-periods: morning and afternoon
- Notation for morning variables $x_t^-$ and afternoon variables $x_t^+$
- Risk-neutral households, traditional and shadow bankers
- Households’ liquidity preference shock: aggregate uncertainty for repo supply

<table>
<thead>
<tr>
<th>$x_{t-1}$</th>
<th>$x_t^-$</th>
<th>$x_t^+$</th>
<th>$x_{t+1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>morning</td>
<td>early afternoon</td>
<td>late afternoon</td>
<td></td>
</tr>
<tr>
<td>▶ consume</td>
<td>▶ repo shock</td>
<td>▶ deposit shocks</td>
<td></td>
</tr>
<tr>
<td>▶ trade T-bonds</td>
<td>▶ trade repo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▶ issue deposits</td>
<td>▶ trade fed funds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▶ trade securities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results
**Proposition 1** In an economy in which LST never binds, the repo rate is always equal to the fed funds rate, and both of these rates are bounded by the interest on reserves below and the discount window rate above:

\[ r_{t}^{m} \leq r_{t}^{p} = r_{t}^{f} \leq r_{t}^{m} + r_{t}^{w} \].
Money Markets without LST
Repo Markets without LST
Repo Markets without LST
Repo Markets without LST
Repo Markets without LST

\[ \lambda - r^m \]

\[ r^p_+ - r^m = r^w \]

reserves lent in repos

excess reserves

overdraft

reserves
Change of Regime

**Proposition 2** When LST is binding:
- the repo rate jumps above the discount window rate;
- there is no transaction in the fed funds market.

▷ Discount window provides *overnight* liquidity ▷ no arbitrage with repo market

▷ LST removes the elasticity of the currency provided by intraday overdrafts at the Fed
Repo Markets with LST
Repo Markets with LST

\[ r^p_+ - r^m = \lambda - r^m \]
Proposition 3 In an economy in which LST is sometimes binding, an increase in the quantity of T-bonds increases the probability of a repo spike through three channels:

- more T-bonds increase the demand for shadow bank repo financing;

- a larger treasury account decreases the supply of reserves available to banks.

- a larger spot issuance of T-bonds increases the settlement needs for reserves;
Treasury Issuance

Central Bank
- T. Bonds
  - Reserves
  - T. Account

Regular Banks
- Reserves
- Securities
- Deposits
- Net Worth

Households
- Deposits
- Future Tax
- Repo
- Net Worth

Treasury
- T. Account
- Future Tax
- T. Bonds

Shadow Banks
- T. Bonds
- Repo
- Net Worth
Treasury Issuance

Central Bank
- T. Bonds
- Reserves
- T. Account

Regular Banks
- Reserves
- Securities
- Deposits

Households
- Deposits
- Future Tax

Treasury
- T. Account
- Net Worth
- Repo

Shadow Banks
- T. Bonds
- Repo
- Net Worth
Fiscal Policy 1

\[ \lambda - r^m \]

\[ r^w \]

\[ r^p - r^m = 0 \]

\[ p_{t+} \]

repo supply

repo demand

intraday reserves in repo

LST locked reserves

excess reserves
Fiscal Policy

**Proposition 3** In an economy in which LST is sometimes binding, an increase in the quantity of T-bonds increases the probability of a repo spike through three channels:

- more T-bonds increase the demand for shadow bank repo financing;
- a larger treasury account decreases the supply of reserves available to banks.
- a larger spot issuance of T-bonds increases the settlement needs for reserves;
Treasury Account

Central Bank
- T. Bonds
- Reserves

Regular Banks
- Reserves
- Deposits
- Securities
- Net Worth
- Repo

Households
- Deposits
- Future Tax
- Repo
- Net Worth

Treasury
- Future Tax
- T. Bonds

Shadow Banks
- T. Bonds
- Repo
- Net Worth
Treasury Account
Fiscal Policy 2

Let's consider the relationship between interest rates and reserves in the context of repo transactions. The diagram illustrates the balance between repo demand and supply, with specific points labeled as follows:

- \( \lambda - r^m \) represents the interest rate.
- \( rw \) indicates a specific threshold or condition within the graph.
- \( rp - rm = 0 \) highlights a condition at a specific point on the graph.

The graph also identifies regions labeled as:

- **Intraday reserves in repo**
- **LST locked reserves**
- **Excess reserves**

These regions help to visualize the interplay between different financial variables and their implications in a fiscal policy setting.
Proposition 3 In an economy in which LST is sometimes binding, an increase in the quantity of T-bonds increases the probability of a repo spike through three channels:

- more T-bonds increase the demand for shadow bank repo financing;

- a larger treasury account decreases the supply of reserves available to banks.

- a larger spot issuance of T-bonds increases the settlement needs for reserves;
Fiscal Policy 3

\[ \lambda - r_m \]

\[ r_w \]

\[ rp - rm = 0 \]

\[ pt^+ \]

repo demand

repo supply

intraday reserves

LST locked reserves

excess reserves

interest rate

repos

reserves
Fiscal Policy 3

\[ \lambda - r^m \]

\[ r^w \]

\[ rp - rm = 0 \]

interest rate

repo demand

repo supply

intraday reserves in repo

LST locked reserves

excess reserves

\[ p_t^+ \]
Monetary Policy

Proposition 4 In an economy in which LST is sometimes binding, a reduction in the central bank portfolio increases the probability of a repo spike through two channels:

- a lower quantity of reserves restricts traditional banks repo lending capacities;
- a larger quantity of T-bonds has to be absorbed by shadow banks.
Treasury Account

Central Bank
- T. Bonds
- Reserves

Regular Banks
- Reserves
- Securities
- Net Worth
- Deposits

Households
- Deposits
- Future Tax
- Net Worth

Treasury
- Future Tax
- T. Bonds

Shadow Banks
- T. Bonds
- Repo
- Net Worth
Monetary Policy

\[ \lambda - r^m \]
\[ r^w \]
\[ rp - rm = 0 \]

repo demand

repo supply

intraday reserves in repo

LST locked reserves

excess reserves

\[ p_{t+} \]

reserves
Monetary Policy

\[ r_p - r_m = 0 \]

\[ \lambda - r^m \]

\[ r_w \]

repo demand

repo supply

intraday reserves in repo

LST locked reserves

excess reserves

\[ p_{t+} \]
Proposition 5 In an economy in which LST is sometimes binding, an increase in the probability of a repo spike is associated with an increase in T-bond yields.

\[ r_{t^-}^b = (1 - \phi_{t^-}^p) \mathbb{E}[r_{t^+}^p | \phi_{t^+}^p = 0] + \phi_{t^-}^p \mathbb{E}[r_{t^+}^p | \phi_{t^+}^p = 1] \]

▷ Moneyness of Treasuries comes from use as collateral in repo markets
We propose a theory to explain recent disruptions in money markets

The theory is consistent with four empirical puzzles
- non-linearities $\rightarrow$ hard constraint $+$ additive effects of fiscal and monetary policy
- spikes despite large reserves $\rightarrow$ intraday scarcity during large settlement days
- no increase in daylight overdraft $\rightarrow$ LST prevents reserves from falling to zero
- banks reducing repo lending $\rightarrow$ LST more binding during large settlement days

Illustrates the need for a permanent repo facility as recently introduced by the Fed
Appendix
**Related Literature**

**Repo markets and regulation:** Duffie and Krishnamurthy (2016); Anbil and Senyuz (2016); Munyan (2017); Bech and Keister (2017); Andersen, Duffie and Song (2018); Macchiavelli and Pettit (2018)

→ highlight the role of intraday liquidity regulation

**September 2019 events:** Afonso, Cipriani, Copeland, Kovner, La Spadan, and Martin (2020), Poszar (2019); Avalos, Ehlers, and Eren (2019); Correa, Du, and Liao (2020); Yang (2020); Copeland, Duffie, and Yang (2021);

→ general equilibrium model in which aggregate quantities and flows matter

**Monetary policy implementation:** Poole (1968); Klee and Bech; (2011); Afonso and Lagos (2015); Bianchi and Bigio (2016); Schneider and Piazzesi (2016)

→ focus on transmission to the repo market

**March 2020 events:** He, Nagel, and Song (2021); Ma, Xiao, and Zeng (2020); Duffie (2020); Schrimpf, Shin, and Sushko (2020)

→ connect Treasury spreads to repo through shadow banks balance sheets
Liquidity Regulation

Liquidity Coverage Ratio (LCR):
- banks have to hold enough liquid assets to cover cash outflows for 30 days
- HQLA level 1: reserves and Treasuries → substitutes
- HQLA level 2: highly rated MBS, covered bonds and corporate debt securities
- computed on monthly average of end-of-day balance-sheets for US banks

Liquidity Stress-Tests (LST):
- Regulation YY’s enhanced prudential standards and Resolution Liquidity Adequacy and Positioning
- applies on top of LCR
- requires banks to pre-fund gross daily outflows in reserves

→ time-varying and depends on expected flows
Tapper + Large Treasury Account → Less Reserves
Policy Options

Option 1: Open a Repo Facility:
- acts as a discount window but for shadow banks
- amounts to setting a second outside option at rate $\lambda_f$ for shadow banks
- requires the Fed to increase its balance sheet on demand

Option 2: Open an Intraday Borrowing Facility:
- allows banks to borrow intraday before reaching zero
- reintroduce elasticity of intraday reserves

Option 3: Allow Expected Discount Window Borrowing to Count for LST:
- allows any collateral eligible at discount window to count for LST
- reintroduce substitutability between reserves and other liquid assets
- inelasticity still there but not binding with much more liquid assets

☐ One is necessary if the Fed wants to (one day) reduce the size of its balance sheet.
Repo Facility

Central Bank
- T. Bonds
- Reserves

Regular Banks
- Reserves
- Securities
- Deposits
- Net Worth

Households
- Deposits
- Future Tax
- Repo
- Net Worth

Treasury
- Future Tax
- T. Bonds

Shadow Banks
- T. Bonds
- Repo
- Net Worth
Repo Facility

Central Bank
- T. Bonds
- Reserves
- Repo

Regular Banks
- Reserves
- Deposits

Households
- Deposits
- Future Tax
- Repo
- Net Worth

Treasury
- Future Tax
- T. Bonds

Shadow Banks
- T. Bonds
- Repo
- Net Worth