Repo Runs

Antoine Martin David Skeie Ernst-Ludwig von Thadden

Day-Ahead Conference on Financial Markets & Institutions
January 6, 2011[1]

[1] The views expressed herein are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of New York or the Federal Reserve System

Introduction

The Theme

- Two key events in recent crisis: Falls of Bear and Lehman
- Common feature: Loss of tri-party repo financing similar to a bank run
- But: run on investment rather than commercial banks
- This paper:
  - Develop a theory of the fragility of wholesale financing
  - Investigate the role of market microstructure for stability
  - Show similarities and differences with traditional bank runs

Introduction

The Tri-Party Repo Market

- A repo is the sale of a security, coupled with the promise to repurchase the security at a specific future date
- The tri-party repo market is particularly important in the US because of
  - its size
  - its role as a funding market of last resort
- Key source of short-term funds for investment banks, mostly overnight
- Key destination of short-term investment for institutional funds

Introduction

The Tri-Party Repo Market (continued)

- Participants: Dealers - Investors - Clearing banks
- The role of the clearing bank makes the tri-party repo market very different from other repo markets
- Clearing banks facilitate the handling of collateral, provide intra-day financing
- Clearing banks "unwind" repos every morning
  - Unwind provides liquidity and reduces transactions costs
  - Investors are not subject to "roll over" risk
  - Increases fragility

Introduction

The Tri-Party Repo Market: Some Numbers

- Outstanding borrowing volume in the US tri-party repo market
  $2002:$ $\$700bn$
  $Peak(2008):$ $\$2,700bn$
  $Today:$ $\$1,900bn$
- Size of largest individual portfolio (mostly overnight)
  $Peak:$ $\$400bn$
  $Today:$ $\$250bn$

Introduction

Deposit-based and Repo-based Banking

The traditional banking model:

- households seek
  - yield and liquidity

Introduction

Deposit-based and Repo-based Banking

The traditional banking model:

- households seek
  - yield and liquidity
- commercial banks
  - offer demand deposit contracts
  - finance long-term illiquid assets

Introduction

Deposit-based and Repo-based Banking

The traditional banking model:

- households seek
  - yield and liquidity
- commercial banks
  - offer demand deposit contracts
  - finance long-term illiquid assets
- deposit demand satisfies the Law of Large Numbers
  $\longrightarrow$ maturity transformation

Introduction

Deposit-based and Repo-based Banking

The traditional banking model:

- households seek
  - yield and liquidity
- commercial banks
  - offer demand deposit contracts
  - finance long-term illiquid assets
- deposit demand satisfies the Law of Large Numbers
  $\longrightarrow$ maturity transformation

Introduction

Deposit-based and Repo-based Banking

The traditional banking model:

- households seek
  - yield and liquidity
- commercial banks
  - offer demand deposit contracts
  - finance long-term illiquid assets
- deposit demand satisfies the Law of Large Numbers
  $\longrightarrow$ maturity transformation

The repo market:

- large investors seek
  - yield and liquidity

Introduction

Deposit-based and Repo-based Banking

The traditional banking model:

- households seek
  - yield and liquidity
- commercial banks
  - offer demand deposit contracts
  - finance long-term illiquid assets
- deposit demand satisfies the Law of Large Numbers
  $\longrightarrow$ maturity transformation

The repo market:

- large investors seek
  - yield and liquidity
- repo dealers (broker/dealers)
  - borrow short-term
  - finance long-term fixed-income portfolios

Introduction

Deposit-based and Repo-based Banking

The traditional banking model:

- households seek
  - yield and liquidity
- commercial banks
  - offer demand deposit contracts
  - finance long-term illiquid assets
- deposit demand satisfies the Law of Large Numbers
  $\longrightarrow$ maturity transformation

The repo market:

- large investors seek
  - yield and liquidity
- repo dealers (broker/dealers)
  - borrow short-term
  - finance long-term fixed-income portfolios
- repo outflows satisfy the Law of Large Numbers
  $\longrightarrow$ maturity tranformation

A Model of the Repo Market

Set up

- OLG model of liquidity provision with infinite horizon
- One physical good that can be consumed, stored, or invested
- Agents: "dealers" and "investors"
- Investors: Continuum of mass N "born" at every date t, endowed with 1 unit of good
  - live for 3 periods, can store the good $1:1$
  - privately learn in $t+1$ whether they are patient or impatient
  - We assume Law of Large Numbers holds

A Model of the Repo Market

Dealers

- M dealers, infinitely-lived, risk-neutral
- Have access to a long-term technology (investment in securities), subject to decreasing returns to scale
- It is costly to transfer securities to investors or other dealers
- Investor funds are scarce and dealers compete for these funds (offer interest rate $\bar{r}$)
- Dealers cannot commit to repay investors and must offer collateral (κ)

Steady-State Equilibrium without Runs

Dealers choose a borrowing and investment policy and investors choose a lending policy such that

- no dealer prefers another borrowing and investment policy
- no investor prefers another lending policy, given the behavior of all others.

Proposition

A unique steady state equilibrium exist where

- *All dealers make strictly positive profits*
- *Borrowing is indeterminate, below some level that depends on collateral*
- *Collateral is indeterminate within bounds*

Individual Dealer Runs without Asset Sales

Dealer under Attack

Questions:

1. Under what conditions will a dealer survive the collective decision of patient middle-aged investors not to continue lending and of young investors not to provide new funds?

Individual Dealer Runs without Asset Sales

Dealer under Attack

Questions:

1. Under what conditions will a dealer survive the collective decision of patient middle-aged investors not to continue lending and of young investors not to provide new funds?
   - Because dealer make profit, they can use the available cash to meet unexpected investor demand

Individual Dealer Runs without Asset Sales

Dealer under Attack

Questions:

1. Under what conditions will a dealer survive the collective decision of patient middle-aged investors not to continue lending and of young investors not to provide new funds?
   - Because dealer make profit, they can use the available cash to meet unexpected investor demand
2. When is such a collective decision self-enforcing for the investors

Individual Dealer Runs without Asset Sales

Dealer under Attack

Questions:

1. Under what conditions will a dealer survive the collective decision of patient middle-aged investors not to continue lending and of young investors not to provide new funds?
   - Because dealer make profit, they can use the available cash to meet unexpected investor demand
2. When is such a collective decision self-enforcing for the investors
   - Depends on collateral (focus on strict incentives to run)

Fragility

The US Tri-Party Repo Market

1. The clearing bank "unwinds" the previous evening's repos:
   1. CB sends cash to all investors of each dealer, extinguishing the investors' exposure to the dealers
   2. At the same time, CB takes possession of the collateral
   3. CB provides collateralized intraday financing to the dealers
2. Some assets mature, reducing the CB's exposure to the dealer
3. Dealer offers new repo contracts to investors
4. New and patient middle-aged investors decide whether to engage in new repos with a dealer
5. A dealer unable to repay its debt to CB is bankrupt

Fragility

- Game between investors:

	other investors: invest	other investors: don't
invest	$\hat{r}$	κ_i
don't	$\bar{r}$	$\bar{r}$

Equilibria:

- (invest, invest)
- (don't, don't) is strict equilibrium iff $\bar{r} > \kappa_i$
- $\bar{r} > \kappa_i$ defines the collateral constraint

Fragility

Proposition

In the tri-party repo market, a run on a dealer can occur and bankrupt the dealer if the dealer's liquidity constraint and collateral constraint are both violated.

Fragility

Tri-Party Repo Without Unwind

1. The dealer offers a new repo contract
2. New and patient middle-aged investors decide whether to engage in new repos with a dealer
3. A dealer unable to repay its debt to last period's repo investors is bankrupt

Two differences compared to unwind:

- Individual investors are repaid iff the dealer can repay everybody
- New and middle-aged investors are in different situations: new investors hold cash, middle-aged investors hold a repo.

Fragility

- Game between middle-aged patient investors:

	other investors: invest	other investors: don't
invest	$\hat{r}$	κ_i
don't	$\bar{r}$	κ_i

- (invest, invest) is unique equilibrium that survives deletion of weakly dominated strategies

Fragility

Lemma

If middle-aged patient investors reinvest, investing is a dominant strategy for new investors.

Proposition

When there is no unwind, there are no strict incentives to run on dealers.

Intuition: Roll-over of repos becomes similar to roll-over of a bond issue, which is not fragile

Fragility

Bilateral Repo Markets

- Settlement of bilateral repos create a first-come-first-serve constraint
- Consider "Fed-eligible" securities: settlement through Fedwire Funds Service®, is DvP, triggered by the sender of securities.
- Once triggered: reserves are automatically deducted from the Fed account of the institutions receiving the securities and credited to the Fed account of the institution sending the securities.

Fragility

Timing:

1. Dealers offer new repo contracts
2. New and patient middle-aged investors decide whether to engage in new repos with a dealer.
3. Investors are repaid in the order in which they send back their collateral, until the dealer runs out of cash. From that point on, investors receive their collateral. Any investor who chooses to invest receives his collateral.

Note: Timing is the same as tri-party without unwind but the settlement process is different

Fragility

Game between investors:

	other investors: invest	other investors: don't
invest	$\hat{r}$	$\hat{\kappa}_i$
don't	$\overline{r}$	$\varphi\overline{r} + (1-\varphi)\hat{\kappa}_i$

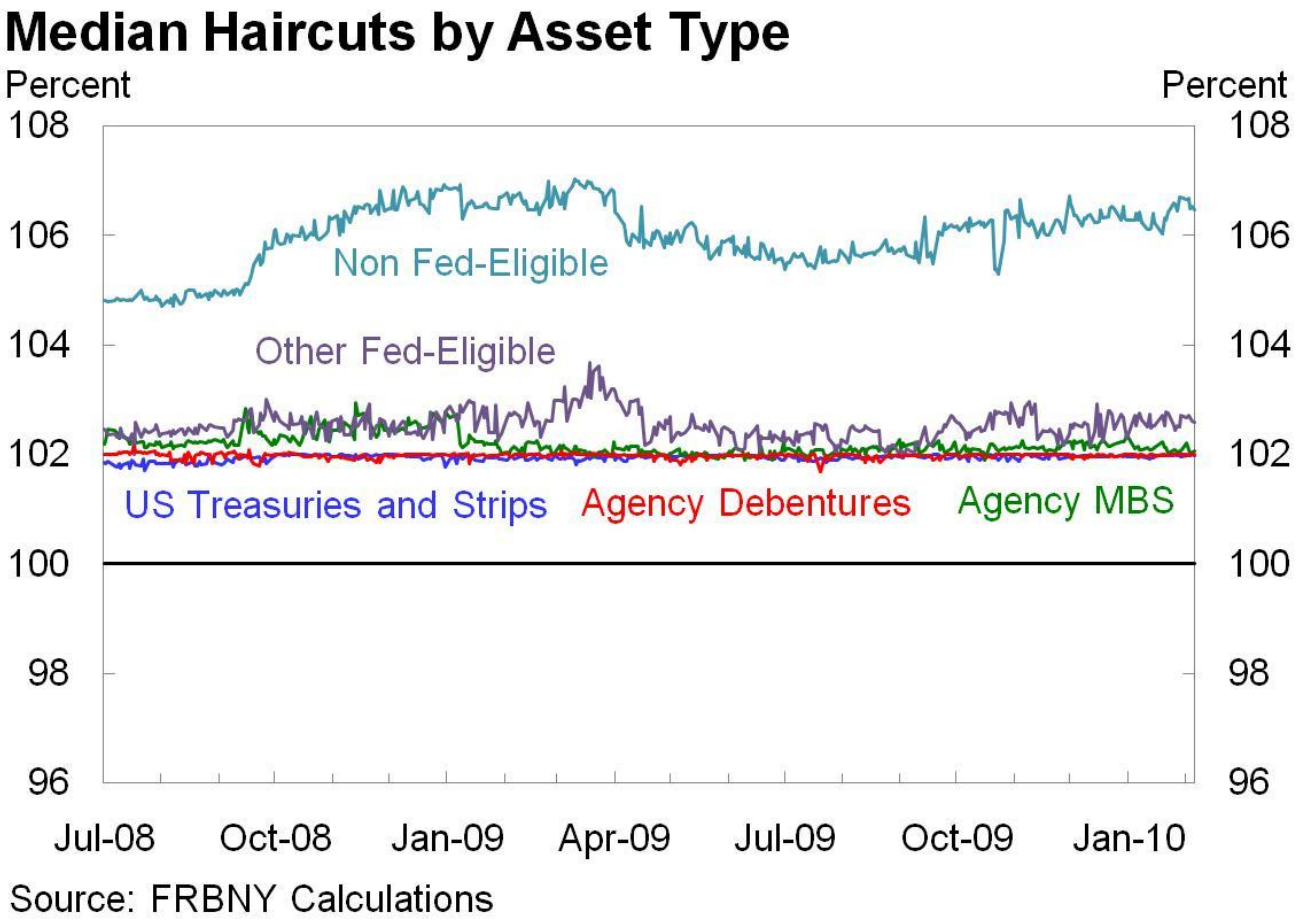
Proposition

In bilateral repo markets, a run on a dealer can occur and bankrupt the dealer if the dealer's liquidity constraint and collateral constraint are both violated.

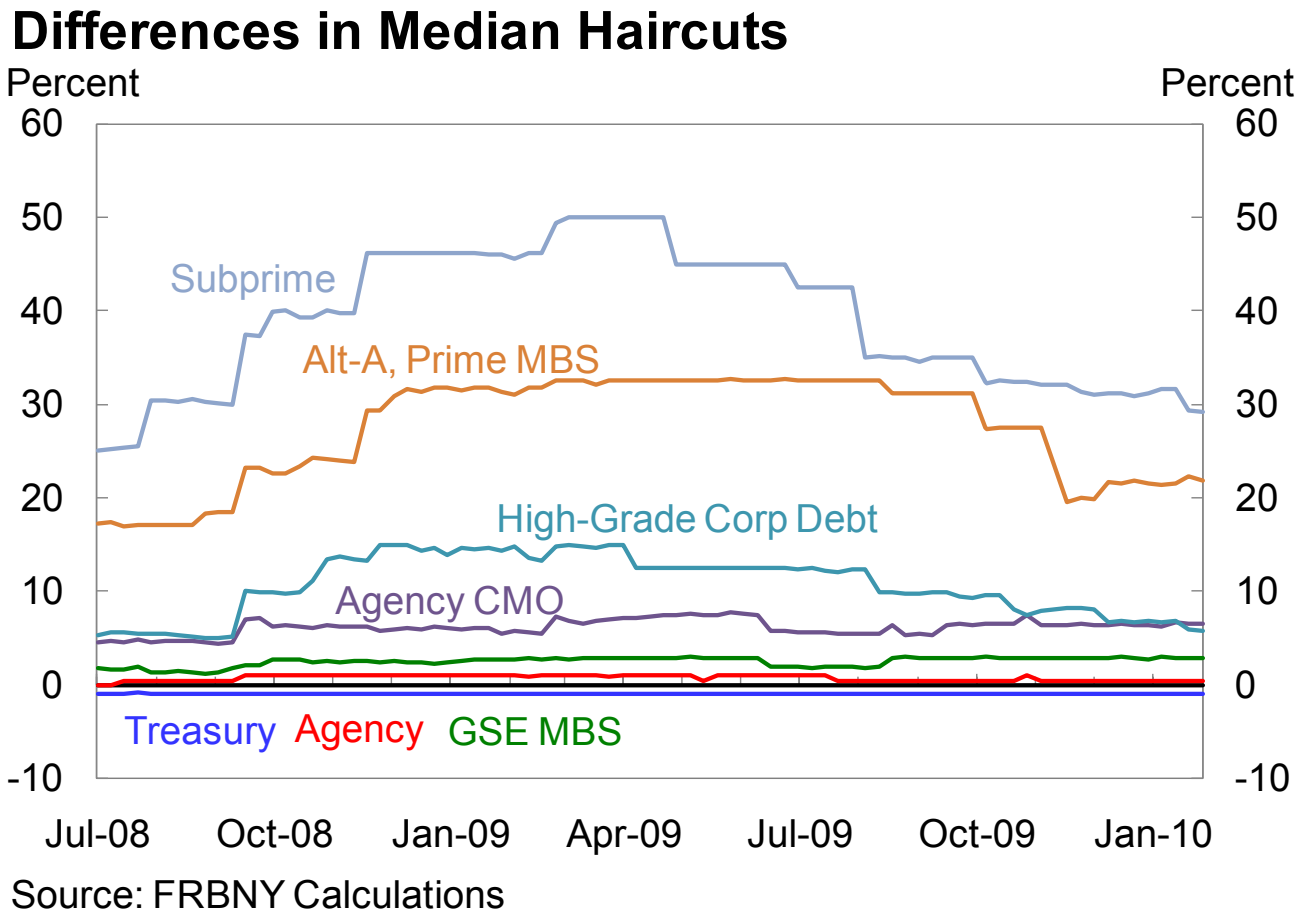
Fragility

- With bilateral repos, we allow dealers to offer more collateral in response to a run
- Increasing haircuts makes bilateral repo market more resilient than tri-party repo market
- We don't provide a deep explanation for the differences between tri-party and bilateral repo markets, but our assumptions are consistent with observed differences
- Under these assumptions, our model can account for different outcomes in the two markets
  - haircuts moved very little in tri-party but moved a lot in bilateral repo market
  - Loss of funding in tri-party was precipitous

Repo haircuts: Tri-party

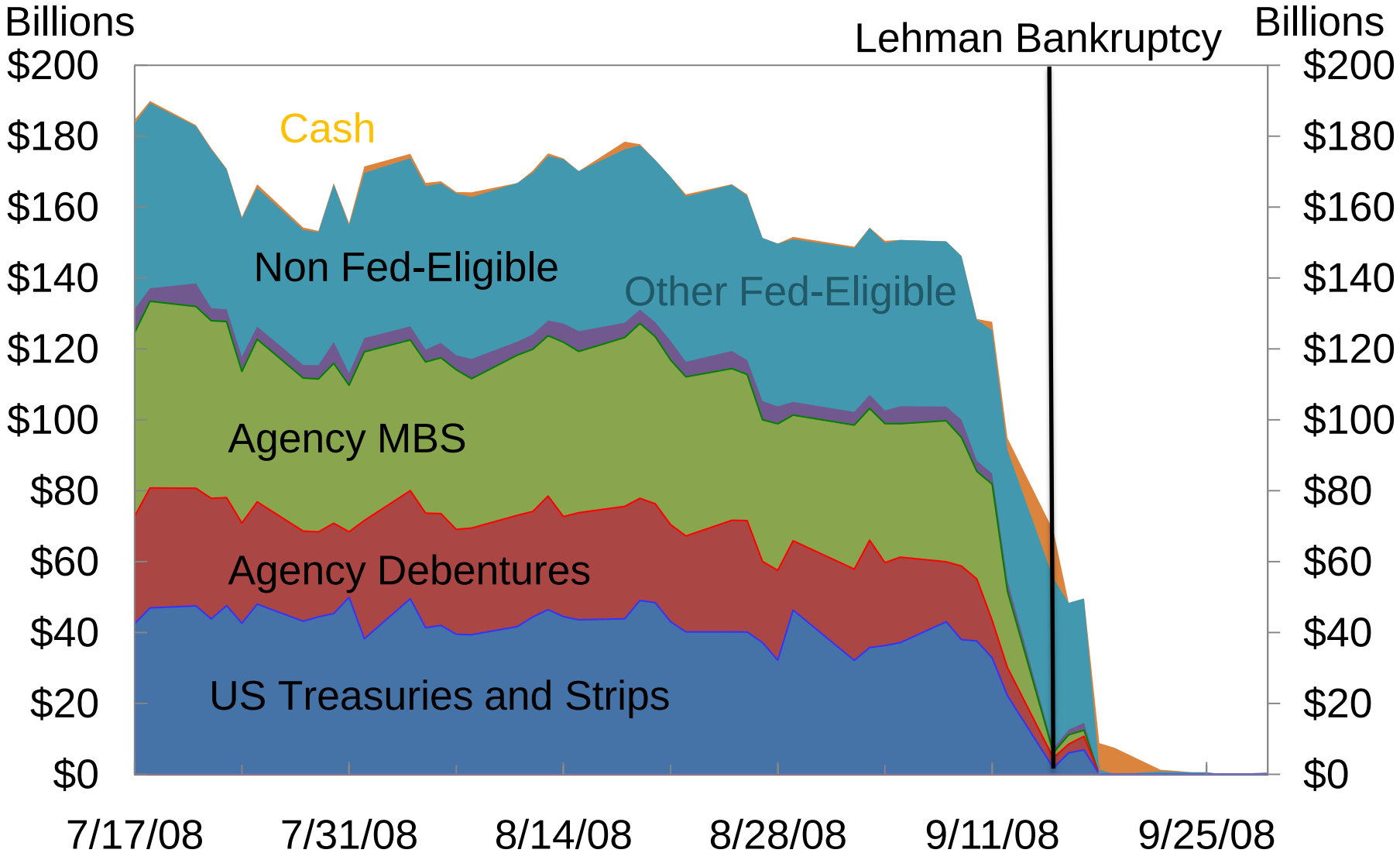


Repo haircuts: DvP vs Tri-party



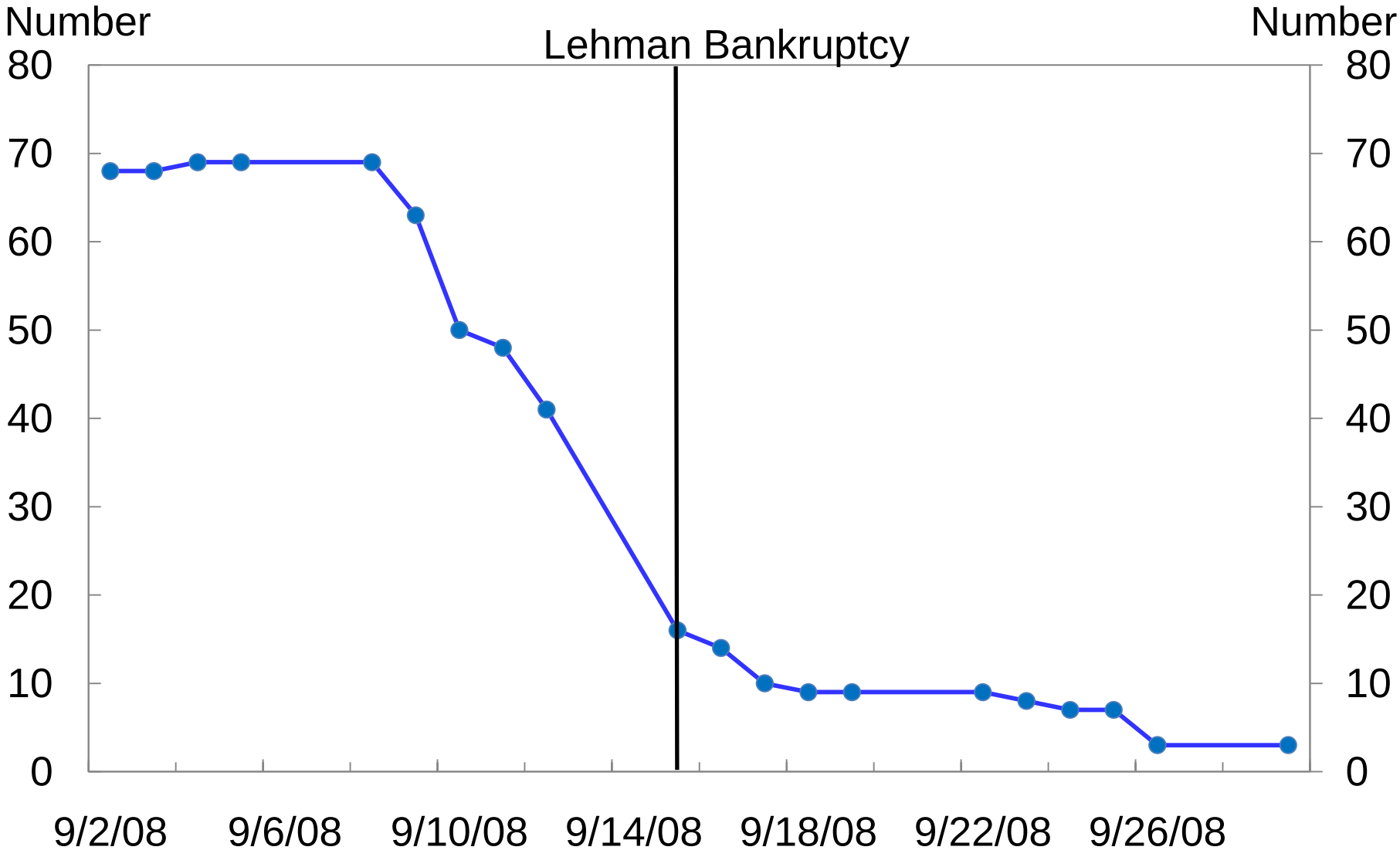
Source: FRBNY Calculations

Lehman's Tri-Party Book



Note: Stacked graph.

Cash Investors in Lehman Brothers



Conclusion

- We build a model of a financial institution that borrow short-term and invests into long-term marketable assets.
- We endogenize the profits of this institutions
- We provide conditions for this institution to be illiquid
- If the institution is illiquid, runs can occur depending on the microstructure
  - We show that current reforms of the tri-party repo market should make that market less fragile
  - We also study microstructure for bilateral repos, MMMFs, and traditional banks
- Under some conditions asset sales can help an illiquid dealer
- Our model makes predictions about the type of dealers we should expect to be safe from a market run