Operational problems and aggregate uncertainty in the federal funds market

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Outline of Presentation

- A quick overview
- The federal funds market
- Settlement of federal funds market
- Operational risks in settlement
- The empirical analysis
- Implications and conclusions
Quick overview

• Question: Do bank-level operational disruptions in the payment system affect money markets, and if so, how? Answer: Yes, in several ways

• The effective federal funds rate can be higher than the FOMC target rate. The magnitude depends on:
  • The length of the outage
  • The time the outage
  • Payment activity of the affected bank

• Reserve Bank overnight loans increase (discount window)

• The effect is transitory; the market is normal the next day.
The federal funds market

Supply factors:
- Net currency in circulation
- Check float
- Government balances
- Open market operations

Demand factors:
- Banks’ funding choices (longer term)
- Payment flows (shorter term)
- Reserve requirements
The federal funds market

• The domestic inter-bank market for unsecured overnight USD funding
• Market conditions reflect the supply of and demand for Federal Reserve balances
  – Supply reflects Fed actions to provide balances (open market operations) as well as external factors: cheque float, currency in circulation, government’s (Treasury’s) fed account balance
  – Demand is determined by banks’ preferences of funding sources, payment flows, and the structure of reserve requirements (maintenance periods)
• Increased uncertainty about end-of-day balances can have an impact
  – Previous studies have focused on the Treasury balance, payment flows
  – Less is “known” about the effect on the federal funds market of completely exogenous, same-day shocks to institutions’ balances
Uncertainty and Incentives

- No interest on reserves
- Discount window at penalty rate
- Timing of reserve periods
- Uncertain payment flows
- Changes in risk aversion

Daily rate variations
Other key factors and incentives

• Reserve requirements are specified as a two-week average; often an increased demand for balances at period-end
• Banks do not currently earn interest on reserves (Fed account balances)—incentive to sell excess reserves
• Discount window rate is a penalty rate; overnight overdraft penalty even higher
• Banks’ payment flows (and need for funds) are partly determined on an intraday, same-day basis
• So, there is strong incentive to manage balances tightly, but uncertainty in flows
The settlement mechanism

Bank A agrees to sell excess balances on its Fed account to B

And delivers them via Fedwire

Federal Reserve Bank

Bank A: +120
Bank B: -100

Bank A

Fedwire

8500 other banks

Bank B
The settlement mechanism

- Banks generally settle their federal funds loans bilaterally in the Fedwire funds service, on a gross basis
- After a loan is agreed (bilaterally or via a broker) the lender will send funds directly to the borrower. Borrower returns funds and interest the next day
- There can be anywhere from a few minutes to a few hours between when the loan is agreed and when it is settled
- Fedwire is a real-time gross settlement system with immediate finality; its closes at 6.30 pm; it has roughly 8500 participants
- Fed funds related payments make up a small number of total payments made over Fedwire; the Fedwire securities system and retail systems also use the same accounts for money settlement
- Reserve Banks provide “intraday credit” to facilitate payment flows; limits on negative balances; a small fee; generally not collateralised
Impact of bank-level operational risk

- Banks can access Fedwire in a number of ways, but most large banks have direct computer interface connections.
- Should a bank suffer a technical disruption, either to their internal operations or to their network connection to Fedwire, they may be unable to send Fedwire transactions in the normal way.
  - But, smaller volumes of offline transfers may be possible.
- Other banks could continue to function, and importantly, send money to the affected bank.
  - Fedwire itself can also suffer outages but then no transactions would occur.
- What does this look like?
Impact of operational disruption

If flows do not occur as expected, balances will not be in the expected places, and may not be available for sale or delivery.
Cumulative percentage of outgoing funds payments by number*

*One-minute intervals.
Account balance*

- Average
- Simulated outage

*One-minute intervals.
Empirical Analysis

Do these outages affect the market for funds?

- Sketch of a model
- Empirical approach
- Data definitions and considerations
- Key results
Sketch of a theoretical model

- A bank has an operational problem and balances are trapped in its reserve account.
  - Supply effects
    - Supply shifts in; trapped funds unavailable for recirculation
    - Counterparties of the affected bank that expected excess balances may be less likely to sell funds now due to unexpected shortfall
  - Demand effects
    - Demand shifts out; lower-than-expected inflows increase need to borrow to meet same payment obligations
    - Demand becomes more inelastic the longer and later the outage as the likelihood of needing alternative sources of funds (discount window borrowing, overnight overdraft) and paying a even higher price increases
- Rates move higher
Empirical Approach

• Use a simple algorithm to identify outlier “time-gaps” in payment sending patterns at individual banks
  – These are simply outliers; they include many known outages
  – Period around 11 September 2001 excluded
• We examine aspects of the federal funds market on days with such possible outages
• Questions to answer
  – Do operational risk events have a measurable effect on the federal funds market?
  – What are the factors that determine the magnitude of the effect?
  – Do these effects persist?
  – How are they related to extensions in Fedwire operating hours?
Definition of “Outages”

• Examined top 50 accounts by sent dollar volume in each quarter from 1998-2005
  – Represents roughly 56 percent of the number and 80 percent of the value of Fedwire transactions sent over the period

• Outages are outliers in the time between two transactions
  – “Outlier” test conditional on sending bank, month, and hour
  – 99.95th percentile of time between transactions
  – And, time gap was longer than 30 minutes
  – (these are slightly “tighter” than those in the paper)
Cumulative percentage of outgoing funds payments by number*

*One-minute intervals.
Data and Definitions

• Effective federal funds rate, intraday standard deviation
  – Volume-weighted average of rates on brokered trades

• Discount window borrowing
  – Adjustment credit: 1998 to 2003
  – Primary credit: 2003 to 2006

• Daily controls for
  – Day of the maintenance period
  – High payment flow days (First of month, mid-month, end-month)

• Outage characteristics
  – Late afternoon is greater than 4pm
  – Participant rank by value sent (top 25, not top 25)
  – Long outage is greater than one hour

• Fedwire extensions derived from data
  – Transactions occurring 10 minutes later than Fedwire “third-party” cut-off
Summary of key results

• The “outages” identified are associated with a deviation of the federal funds rate from the target
  – Later and longer disruptions by higher-ranked banks yield an effective rate higher than the target
• Some additional intraday volatility
• Discount window borrowings also higher
• The effect is generally transitory, and the market returns to normal the next day
• Fedwire hours are more likely to be extended when an outage occurs in the afternoon
Effect of outages on deviation from the target

- Outage
- Afternoon
- Long
- Top 25
- Extension
- Sum
- Midmonth

Characteristic

Basis points

-2
0
2
4
6
Effect of outages on intraday standard deviation

- Outage
- Afternoon
- Long
- Top 25
- Extension
- Sum
- Midmonth

Basis points
Effect of outages on primary credit borrowing

- $E(p_c | p_c > 0)$
- Outage
- Afternoon
- Long
- Top 25
- Extension
- Sum
- Midmonth
- Month end
- Month start
- Quarter end

$[$ millions$]$
“Treatment” effect of extending Fedwire hours

• Problem
  – Requests for extensions depend on the severity and time of the outage
  – Deviation from the target also depends on these

• Implication
  – Probability of an extension and deviation from target jointly determined

• Solution
  – Evaluate deviation from the target simultaneously with probability of an extension

• Results
  – There is a significant correlation in the deviation from the target and the probability of an extension
  – Estimates suggest that an extension alleviates pressures on the funds rate, but more work is needed to determine the point estimate for new data set
Implications and Conclusions
Quick comparison to recent events

• How does the impact of operational risk events compare to that of the recent market turmoil?

• Recent intraday volatility much higher than “outages”
• In contrast, effective rates have recently been below or at target (as the central bank is able to react?) while outages push effective rates higher
• Does the unpredictability and quick development of operational disruptions make it more difficult for the central bank to respond before rates move higher?
Fed funds rates and intraday volatility in the recent period

Source: FRBNY
Deviation of Fed funds rates from target and intraday volatility before and after recent turmoil and compared to "outage" findings

1 June to 9 August  9 August to 14 September  17 September to 31 October  Outage Results (All Effects)

Graph showing basis points deviation with values from 8 to -70.
Conclusions and Considerations

• Operational risks have external costs. What should be done to prevent them? Can their impact be limited?

• Banks’ business continuity plans are critical to prevent market disruptions. How much resilience is required?
• Does the centralisation of operational processes and liquidity management for large banks mean that multiple money markets could be affected simultaneously?
• Are there system mechanisms that can increase certainty in settlement flows and prevent effects on the markets?
Annex
Empirical methods

• Evaluate an EGARCH model to determine the effect of outages on the federal funds rate
  – Allows for asymmetry of negative and positive shocks to variances

• Evaluate a treatment effect model to determine the influence of extensions on the funds rate
  – Evaluate a probit model to determine the effect of outages on the probability of an extension
  – Use predicted probability as an instrument in the funds rate equation.

• Evaluate a tobit model to determine the effect of outages on discount window borrowing
Summary statistics for outage variables

- Outage
- Top 25
- Longer than one hour
- Late afternoon
- Extension